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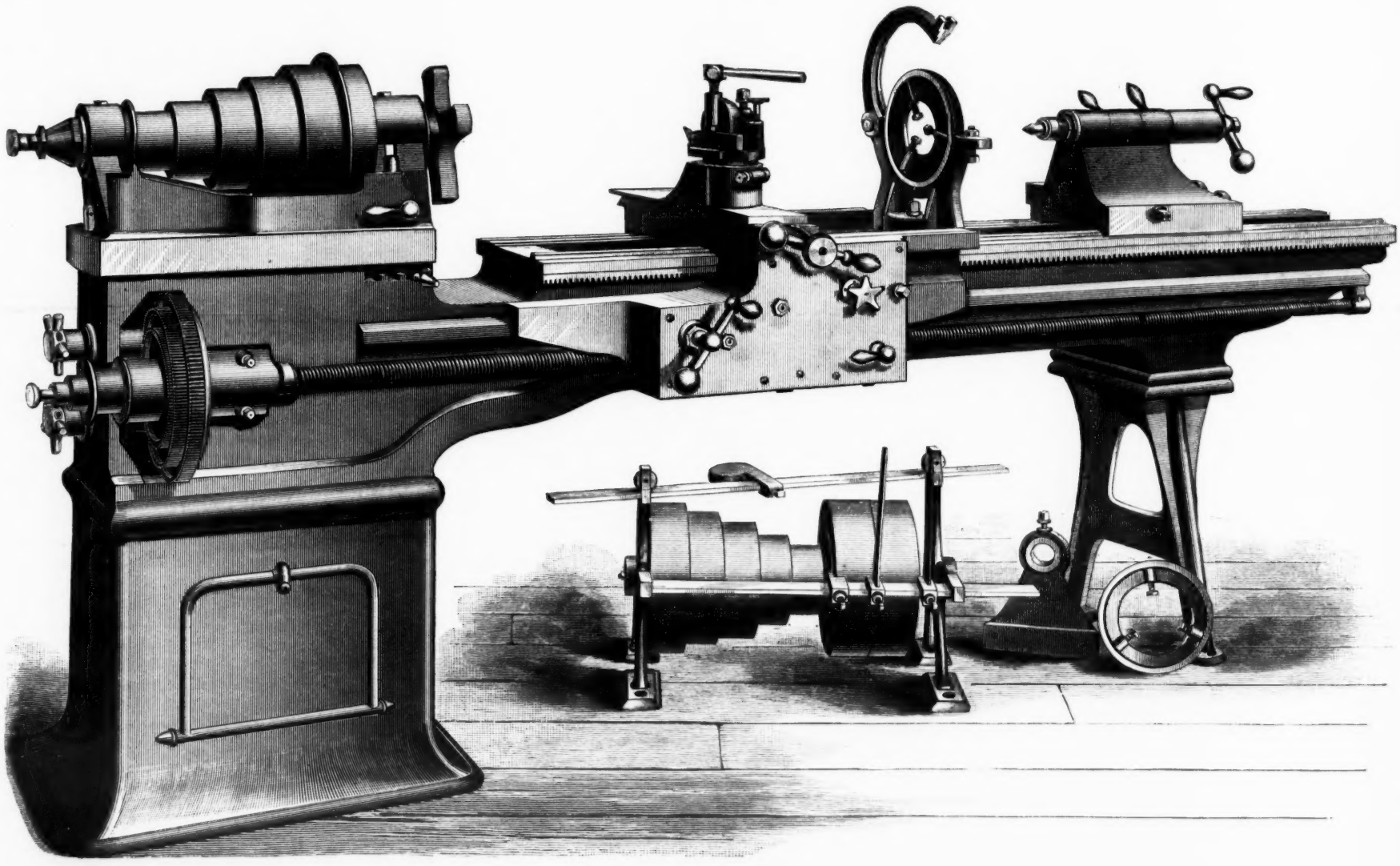
## Sweet's 16-Inch Engine Lathe.

BY PROF. C. I. KING.

The following is a general description of a new 16-inch engine lathe, built for the Straight Line Engine Co., Syracuse, N. Y., which I think has a good many novel features, and which may interest some of your many readers.

In this machine the cone has five steps in place of four, the usual number. This is accomplished without increased length of head stock, by the use of internal gears. The head stock rests on a flat surface on the bed, and will swing in either direction for boring tapers. A zero mark is placed on the head stock, and the arc at the end of the bed is graduated so that it reads in inches to the foot. The arbor is of steel, is hollow, and is hardened and ground at the main bearing, which is conical, while the back bearing has a hardened and ground sleeve, also conical. This arbor carries a bevel gear back of the face plate, which engages with another gear driving a short vertical shaft, the gears being covered to keep them free from dirt. This vertical shaft has another bevel gear on its lower end, which engages with one of two others on either side of it, as the operator may desire, in running the feed train in either direction. The vertical shaft can also be dropped down to disengage the gears at the arbor. The head stock swings on a collar set in counterbores of equal dimensions in the two surfaces, so that no wear occurs at this point except from the occasional setting for tapers. The entire bed under the head stock is cast hollow, and contains the screw-cutting gears in position. These gears are held in place at their hubs, and only such pairs revolve as are in use. This is accomplished by a pair of split, hollow sleeves, which are caused to slide up an inclined plane on an inside shaft, and expand in the hub of the desired wheel. To do this a star nut is used, with a projecting hub, inside of which is cut a differential screw, one thread screwing on the sleeve, the other on the shaft. On these sleeves are marked the number of threads which may be cut by each set of wheels; each position cutting three different pitches by the use of the three wheels on the end of the leading screw. These three wheels are so arranged that when one is in position the other cannot be moved, and the locking takes place automatically, the wheel in use being held to position by pulling out a pin in the end of the screw. The support for the head of the lathe is of the usual box form, though it is somewhat larger than is general for this size of lathe. The opposite end rests on a pair of legs, having two flanges extending into the short box projecting from the bed, and through which, in the direction of the length of the bed, a pin is passed, thus giving a pivoted-support and introducing the three-leg idea. The sides of the bed are connected by U-shaped girts. The only guide for the foot stock is on the front side, the surface at the back side of the bed being flat. The main guide for the carriage is at the front, and about five inches below the top. This guide also projects far enough to protect the main screw from dirt. The bed is open at the foot stock end, so that this piece may be slipped off the bed by simply unclamping it. The bed also has a gap at the head stock end, eight inches wide, in which 24 inches diameter will swing clear. The foot stock is clamped in position by a lever and eccentric. The usual pinch hub for holding the foot stock spindle is dispensed with, and a split sleeve, with taper at each end, is made to compress it at two places, eight inches from each other. This foot stock is also arranged so that the two centers can be made to point toward each other in turning tapers. The carriage has an exceptionally long bearing on the guide, and all of its shafts have bearings at each end. The carriage can be locked in position by a block moved by an eccentric. When the lathe is used for screw cutting, by means of an index the nut may be thrown in and out at pleasure in cutting any screw. When the nut is in connection with the screw, an eccentric disc is turned in such position that the friction feed cannot at the same time be applied, and, conversely, when the feed is in use the nut cannot be thrown in. The cross-feed screw has two threads, so arranged that the slide travels twice as fast as the screw, and the tool post, which is of the Lipe pattern, will come out to a 12-inch radius. The length of the slide is equal to the width of the carriage. At the back of the carriage is a device which withdraws and advances the tool in thread cutting at the right moment, so that the operator need only to set the tool for the new cut. Motion is imparted to the train in the carriage by means of 45-degree spiral wheels, and to the cross-feed by a spiral wheel and a four-pitch worm. The whole inside mechanism of the carriage can be exposed by removing five screws, and taking off the apron.



The center rest is provided with two loose rings of different sizes, having pointed set screws projecting from the inside, by which the stock is held. The countershaft is, I think, entirely different from others, in that the usual boxes are dispensed with, and the shaft is screwed in the hangers—the whole cone and driving pulley being fast on one sleeve, which turns on the shaft, and the loose pulley turns on the same sleeve. A carrier is also provided for shifting the belt on the upper cone.

The ingenuity and originality of thought shown in this tool, and its beauty of outline, are due to Prof. John E. Sweet. The patterns were made, and the machine work was done in the shops of the University of Wisconsin, at Madison, much of the work being done by the students.

## Modern Locomotive Construction.

By J. G. A. MEYER.

NINETY-SECOND PAPER.

There are various ways of attaching the throttle work to the boiler. Sometimes we are compelled to run the throttle lever connections through the top of the boiler; but generally the throttle rod passes either through the back head of the boiler, or it passes through the sides of the dome. Figs. 513, 514, 515 represent a throttle valve lever and its attachment, suitable for engines in which the throttle rod *H* is passed through the back head of the boiler.

This throttle lever is probably the simplest in design used on locomotives. The back head *P P* of the boiler is bored out to receive the spherical portion of the stuffing-box *C*, the two forming a ball joint; this joint is a ground one, so as to make it perfectly steam-tight. The stuffing-box is fastened to the boiler head by four studs, *L M K K*; the studs *K K* are made long enough to take hold of the stuffing-box gland. The form of the nut on the stud *M* is made suitable for receiving a pin, on which the two links *O O* vibrate. These links are also connected to the throttle lever *A*, and act as a fulcrum. The throttle lever *A* is connected to the throttle rod *H* by means of the jaw *I*. In a few instances this jaw is screwed onto the rod *H*, but generally the jaw is bored out to a taper, accurately fitting the tapered end of the rod *H*, which is driven into the jaw, and held there by means of the tapered pins *G G*; in some cases, only one pin in place of two is used. The taper on the end of the rod *H* is generally $\frac{1}{8}$ of an inch in 2 inches. The throttle lever rests on the lever arc *B*, which is fastened to the boiler head by means of one stud; in a few instances, two studs are used for the same purpose. Through the lever arc *B*, a slot is cut for the clamping bolt *F*; the nut *E* for this bolt is capped with wood. The throttle lever *A* is clamped to the lever arc *B* in any position which gives the throttle valve in the dome the desired degree of opening.

This design of lever is often adopted on account of its simplicity; but it is not a convenient one for the engineer to handle, because in order to open, close, or adjust the throttle valve with this kind of lever, the engineer may have to use both hands, a condition which is not only inconvenient, but, in a case of emergency, is objectionable.

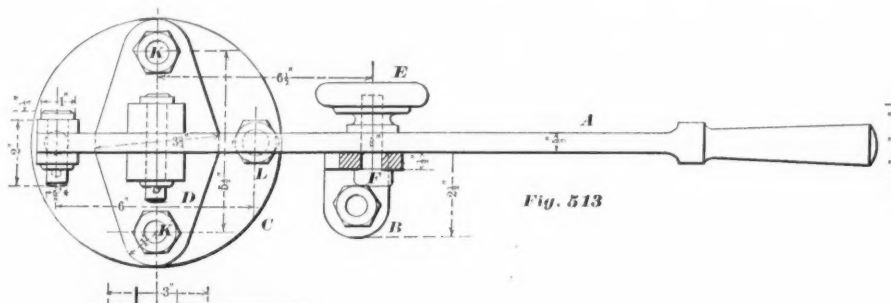



Fig. 513

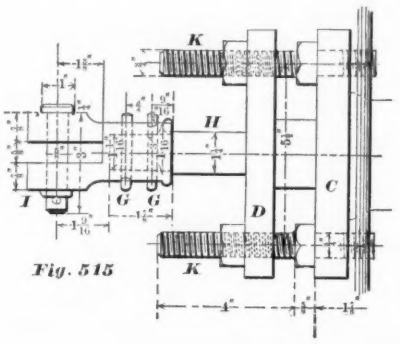



Fig. 515

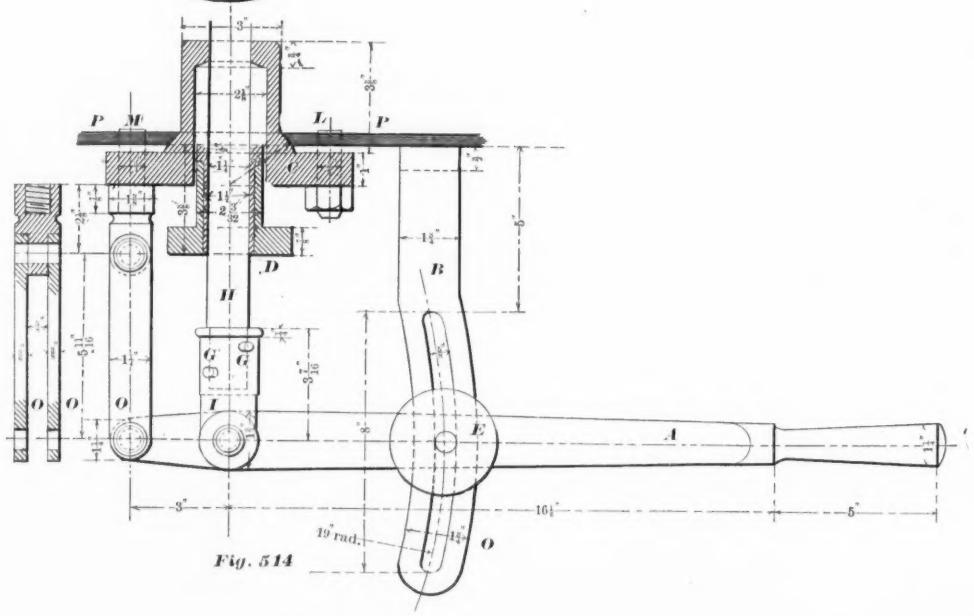



Fig. 514

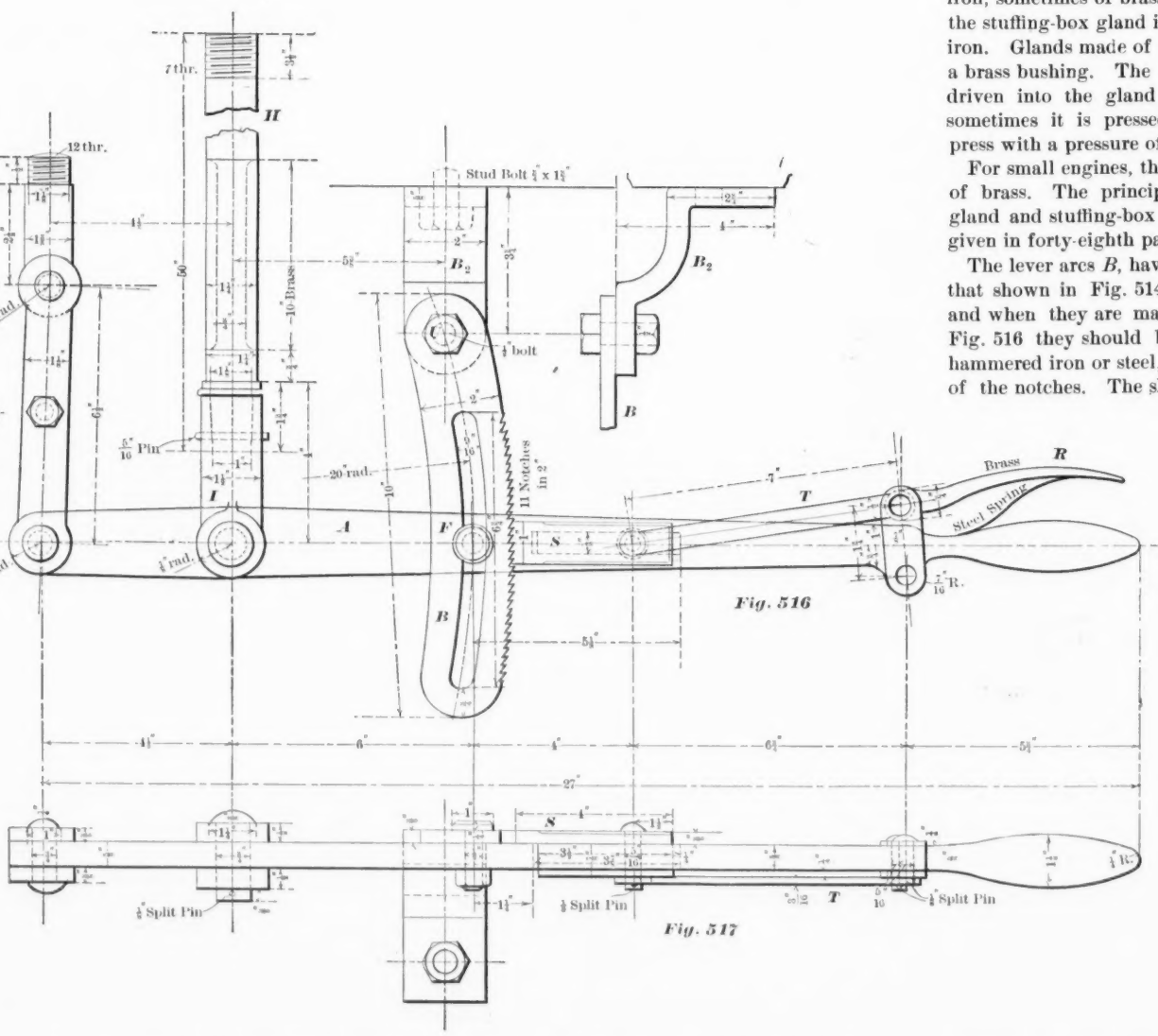



Fig. 516

Fig. 517

Figs. 516, 517 represent a throttle lever and attachments designed to remove the objectionable feature inherent to the former one. The difference between the two designs of throttle lever and attachments lies in the design of the lever arc *B*.

In Fig. 516 it will be seen that on the convex edge of the arc *B*, notches are cut which engage with corresponding teeth on the end of the latch *S*; this latch is connected to the handle *R* by the link *T*. It will readily be perceived that, with this arrangement, the engineer can with one hand disengage the latch, move the lever into any position, and allow it to lock itself there.

The manner of fastening the lever arc *B* (Fig. 516) to the boiler differs somewhat from that shown in Fig. 514. In the former figure it will be noticed that a bracket $B_2$ is fastened to the boiler, and the arc *B* is attached to this bracket. In many engines the bolt *U* does not hold the arc *B* rigidly to the bracket, but allows it to vibrate a little, so as to adjust itself to any position of the lever *A*. Under these conditions, we need in the arc *B* a slot cut equidistant from the notched edge of the arc. In this slot a bolt *F* is accurately fitted, and prevents a disengagement of the arc *B* and the latch *S*. The arc and latch are usually placed above the lever; in such cases, the bolt *F* will tend to prevent the lever from moving out of its appointed plane of action, and help to produce steadiness of motion.

The diameter of the throttle rod *H* varies for the different sizes of engines; for small engines it is about $\frac{3}{4}$ of an inch, and for large engines about $1\frac{1}{4}$ inch.

To place the throttle rod *H* in position, it must be passed through the stuffing-box; hence, collars on the rod are not admissible. When these rods are made of uniform diameter throughout, they must be turned throughout their whole length; to save time in turning, a large portion of the rod, extending to within a short distance from the ends, is forged about $\frac{1}{16}$ of an inch smaller in diameter than the required finished diameter at the ends, leaving at the throttle lever end a portion to be finished, of such length only as may be required for the movement of the rod in the stuffing-box, and leaving at the throttle pipe end a portion of such length as may be required for the thread.

Sometimes that part of the rod which works in the stuffing-box is provided with a brass casing, as shown in Fig. 516. This brass casing is cast on the rod; its object is to prevent a collection of rust between the rod and stuffing-box. The portion of the rod covered by the brass lining is generally forged to an octagon form.

The stuffing-box is generally made of cast-iron, sometimes of brass. For large engines, the stuffing-box gland is often made of cast-iron. Glands made of cast-iron have always a brass bushing. The bushing is sometimes driven into the gland with a hammer, and sometimes it is pressed in by a hydraulic press with a pressure of about 100 pounds.

For small engines, the gland is often made of brass. The principal proportions of the gland and stuffing-box are found by the rule given in forty-eighth paper.

The lever arcs *B*, having a form similar to that shown in Fig. 514, are made of brass, and when they are made like that shown in Fig. 516 they should be made of the best hammered iron or steel, so as to prevent wear of the notches. The shape of the notches is similar to the shape of teeth in an ordinary circular saw; the notches are cut so as to bring their radial sides towards the boiler. Notches of this kind will prevent the throttle valve from flying open, and yet it can be very easily closed.

Sometimes the throttle lever *A* is placed in a horizontal position; in many engines it points upwards, and occasionally it points downwards.

The proper position of the throttle lever will depend on the position of the stuffing-box in the back head, and the position of the reverse lever.

The stuffing-box is placed as high in the back head as is possible and practical to do, and determines the position of that part of the throttle lever which connects it to the throttle rod. The handle of the throttle lever should be as close as possible to the handle of the reverse lever, the latter being placed

in a convenient position for the engineer to reach; hence in this way the position of another part of the throttle lever is found, and the plane in which it is to move is established.

The distance between the extremity of the throttle lever handle and that of the reverse lever should be about 2½ to 3 inches, so as to prevent the engineer from jamming his hand between the throttle lever and reverse lever handles; hence this condition will determine the length of that part of the throttle lever which extends from the center of the throttle rod to the extremity of the handle.

### Topical Discussions at Erie.

As we have elsewhere intimated, there was but little time devoted to topical discussion at the Erie meeting of Mechanical Engineers. The first question discussed was one in relation to the best way to lubricate main and counter-shafts. The discussion soon drifted to crank-pins for steam engines, Professor Denton thinking that it was not practicable to use grease on these pins, while Mr. Hemenway had used it successfully where the pin was small for the work, and oil had failed to keep it cool. The experience of the members was contradictory as to the use of grease on crank-pins and fast-running machinery, some having used it with success on the crank-pins of high-speed engines and on the journals of dynamos, while others did not approve of its use for such purposes. Getting back to shafting, it was found that but little was known, or at least told, by the members about the journal friction, and it was thought that a knowledge of the difference in friction, when different kinds of lubrication was employed, would settle the question as to the best lubricant. Mr. Hemenway thought that, in the absence of convenient means for determining the exact power required to run the shaft, a very fair comparison might be made by noting the temperature at the journals when different lubricants were used. Mr. Towne thought this plan might work in the case of crank-pins, but not for shafting, the conditions being different. Mr. Hemenway still thought the temperature of the journals a very good exponent of the work done in turning the shaft in the boxes. This work would appear as heat, no matter whether heavy oil, light oil, grease, or no oil at all was used. Some members favored the use of so-called grease candles, which were found to work very well indeed. Finally it was suggested that there might be a difference in the quality of the grease experimented with, and that some boxes might be better suited by construction to use grease than others.

The next question was whether it was right or wrong to put a central support under the bed-plate of engines of the Corliss type. The prevailing opinion appeared to be that if the bed was strong enough there was no need of a central support. When the girder-bed first came into use lower steam pressure was carried, and speed was less. The beds had not been strengthened, as they should have been, for the higher pressure and speed.

The discussion was then upon the policy of turning down bolts between the head and the nut. Professor Sweet found that turning them down to the bottom of the thread saved the bolts. When not proper to turn them down, the cross-section should be reduced correspondingly by drilling a hole, longitudinally, from the head to the thread. Mr. Rice practiced turning down the body of bolts to smallest diameter of thread, and gave an example of such bolts stretching, instead of breaking, when subjected to sudden strain. Professor Wood gave a blackboard illustration of the reduction in section of a piston rod of a steam hammer just beyond the head. Previous rods had broken in the head, but this one held. Mr. Whitehead illustrated the turning down of a milling machine arbor, which avoided breaking at the shoulder.

In discussing the economy of rope transmission for distributing power as compared with distribution by electric motors, T. S. Miller gave an instance in which the problem was to distribute power through a warehouse 150x350 feet in Chicago. There were electric lights to be installed, and it was claimed that the cheapest way to get power through the building was to place an electric motor at each machine. Mr. Miller convinced them that manila rope driving would be best, and this was used, the result being that the friction of rope and countershafts was but 20 per cent. of the work done by the engine, which was 10 per cent. better than the advocates of electric distribution claimed to be able to do.

### Twin Screw Steamer Augusta Victoria.

The steamer Augusta Victoria is another ocean racer which will undoubtedly receive, as she justly deserves, a large share of the patronage of ocean travelers. She is the first of the new twin screw steamers with which the Hamburg-American Packet Co. inaugurates its new express service from New York to Southampton and Hamburg.

This steamer has just completed her first voyage to New York, and it is claimed that she has made as good if not better time than that made on the first voyage of any other steamer. She was built by the Vulcan Shipbuilding Company, Stettin, Prussia, and launched on the first of December, 1888. It may be said here that this vessel, besides others built lately by the same firm, has given the Vulcan Shipbuilding Company an excellent reputation for steamship work on a larger scale than ever before attempted in Germany.

The length of this new steamer is 460 feet; width, 56 feet; depth, 38 feet; displacement, 10,000 tons. Her main engines are of the upright triple expansion type, and in their construction steel has been used to a very large extent. The cylinders are 40, 60 and 109 inches diameter; stroke, 5 feet three inches. Each engine develops 6,250 horse-power, making a total of 12,500 horse-power. These engines work independently of each other, and are separated by one solid, longitudinal bulkhead running through the whole length of the ship, and extending to the upper deck, dividing the vessel into non-communicating halves. There are eight double boilers placed in three water-tight compartments, so that, even if two of the boiler compartments should be flooded, the boilers in the third compartment will be able to keep one of the engines working The boilers are constructed for a working steam pressure of 157 pounds per square inch, and burn about 220 tons of coal daily. The steamer was constructed under a guarantee from the builders that her speed would exceed 19 knots, or 21¾ miles per hour; and it is claimed that on her trial trip she made 20 knots, or 23 miles per hour.

Besides the longitudinal bulkhead referred to there are other bulkheads, subdividing each half of the ship into numerous water-tight compartments, which do not communicate with each other, so that a person, in passing from one compartment to another, must ascend to the upper deck. In case of a leak, a compartment might be filled with water without affecting the buoyancy of the ship; and in case of fire such compartment could be quickly flooded by the steam pumps.

The hull of the ship has a double bottom, the space between being divided after the Brackel system, into chambers, which can be filled with water or emptied, by means of automatic pumps, thus increasing or decreasing the draught at will, and guarding against any accidents from grounding.

The steamer has two keels, one on each side, thereby lessening the draught, and, to some extent, preventing the rolling motion, keeping the screws under water, and increasing the speed.

The rudder is connected to a steam steering gear. The steering power of the ship can be increased at will by the twin screws, so that, if one of them is reversed while the other goes ahead, it is claimed that the vessel can be turned almost within its own length. If the rudder should become unmanageable or get lost, the ship would still remain under control, its course being directed by the independent action of the screws.

All parts of the steamer are illuminated by electric light.

The promenade deck runs almost the whole length of the ship, and offers a good facility for open air exercise. Fourteen state-rooms, ladies' saloons, smoking-rooms and music-room are on this deck.

The main saloon, 64x32 feet, officers' rooms, and eight outside state-rooms are on the upper deck. On each side of this deck a promenade six feet wide extends nearly throughout the whole length of the ship.

A saloon, 40 x 20, and most of the state-rooms are on the main deck.

The decoration of the saloons is magnificent, and is a masterpiece of German decorative art. The state-rooms are fitted for comfort and convenience, provided with electric bells connected with the steward's pantry.

The total number of engines used for various purposes on the ship is forty-eight.

The steamer has sharp lines, straight stem, and a well-rounded stern.

The three masts are comparatively low, and without yards. Three funnels rise from the hurricane deck, which, although of large dimensions, have a tendency to bring out the symmetry of the whole, giving the vessel a very graceful appearance as she rests upon the water.

Her sister ship, the "Columbia," is approaching completion at Birkenhead, England, and other steamers of the same character are soon to be added.

### Discussion on President See's Address.

In our issue of May 16 we gave a synopsis of President See's address before the American Society of Mechanical Engineers. Mr. See believes that the place to learn a trade is in the shop, and is not in harmony with those who advocate trade schools and manual training. At the next session after the delivery of this address, by special request it was brought up for discussion.

In opening the discussion it was hoped the sentiments of Mr. See would not be allowed to go out as the expression of the society. Mr. See had attacked manual training, in which the State of Pennsylvania was greatly interested. Manual training was distinct from trade schools, but Mr. See did not appear to see the distinction. No argument against trade schools would apply to manual training. In manual training no effort was made to teach a trade. The only effort was to teach familiarity with tools, and the use of the hands and eyes. The speaker went on further in setting forth his views of the advantages of manual training, his argument being substantially the same as that used by others who favor its adoption.

Professor Denton thought injustice was done Mr. See. There never would be greater engineers than those of the past. He believed too much stress was placed upon the manual part of education. It would undoubtedly be of some use in the future progress of the student, but the advantage was limited.

Unfortunately, Mr. See was prevented by sickness from being present to defend his position.

The purchase by the authorities of the State of New York of three Westinghouse dynamos, for the purpose of generating an alternating electric current for the execution of criminals, will probably be somewhat of a surprise to the electric companies using the alternating current, who, in convention at Chicago last January, adopted a resolution declaring that no company should allow a current in its control to be used for the "ignoble purpose" of executing murderers. We really cannot see, though, how such use of these dynamos can do anything towards demonstrating the danger of alternating currents not already understood, for it has been repeatedly proven the ordinary currents which are run about the streets are fatally dangerous, and the conditions under which the current will be applied in executions will be so different to those present in an accidental contact with an exposed wire, that we do not see how much light is to be thrown upon the question of the danger to life encountered in our streets.

### Eastward Passage of the Steamer "City of Paris."

The steamer "City of Paris," of the Inman line, has outdone her previous westward achievement, by making the fastest eastward passage on record. She arrived at Queenstown, on May 21st; the journey lasted five days, twenty-two hours and ten minutes.

Another death by electricity, for which there seems to have been no necessity or excuse whatever, occurred in the North River tunnel the other day. The tunnel is lighted by electricity to facilitate the work in it; and a young man, who had recently come on from San Francisco in search of employment, and had found it in the tunnel, accidentally touched a wire and was instantly killed. We do not see how there can be the least shadow of an excuse for such an occurrence; in the first place, the tunnel can be lighted by a current of electricity which would not be fatal under any circumstances; and, in the second place, if currents of deadly pressure are to be used, the means for perfectly insulating the wires, so that no harm can come from them, are well understood, and the adoption of such means is simply a matter of dollars and cents. The North River tunnel has in years past been the scene of quite a number of deaths; and there is danger enough in it, even when everything is made as secure as possible. The adding of non-insulated high tension electric wires to the other and ordinary dangers of tunnel digging is nothing else than grossly criminal.

A Chicago paper has the following: The wear and tear on the North Side Cable loop-line has been something fearful from the first, and the frequency with which new cables have had to be purchased was cutting considerable of a figure in the expense account of the road. So Mr. Yerkes sent for the wise man of San Francisco who is supposed to know all about cable roads. He looked things over and said: "Oh, we can fix this easily. Your grips wear out the rope. I'll grease the rope, and then the friction will be reduced." So Mr. Yerkes' men greased that loop-line, and since then the cable is so slippery that when the grip strikes a place that brings an extra strain on it it fails to hold to the rope, the car stops, and the passengers walk.

J. I. Thornycraft read a paper before the Institute of Naval Architects (England), in which he favored the use of water tube boilers in the navy. This, he argued, would reduce the weight of boilers, and bring about greater economy in the use of fuel. The fact that, with the water tube boiler, steam could be got up in a much shorter time, tended to economy, because when steam could be raised in fifteen minutes it would be necessary to keep steam on one boiler only for the purpose of starting the auxiliary engines and warming the main engines.

Those who, a year or two ago, believed that a great era in railroad building had begun in China, are beginning to lose faith in their predictions. The fact is, that China proposes to manage her own affairs, and when railroads are built there to any extent it will undoubtedly be after the materials of construction are made there. Men have before this worked up gigantic schemes to furnish the Chinese Government with machinery, and although they were promising at the start they soon miscarried.

It begins to seem probable that the old-fashioned murderous car coupler will be abandoned after a time. The Assembly of the State of New York recently passed, by a very large majority, a bill requiring all freight cars in the State to be equipped with automatic couplers.

A writer in the *Sun* says the steamship "Pacific," of the Collins (American) line, crossed the Atlantic in the fall of 1850 in nine days and eighteen hours, breaking the record,

### A New Draftsman's Protractor.

The protractor illustrated herewith consists essentially of two parts, *A* and *B*, made of hard rubber, about $\frac{3}{16}$" thick, the lower and right-hand sides of *B* being at right angles to each other, while the left-hand side is at an angle of 45°, through which angle the part *A* turns in *B* in the manner indicated in Fig. 2.

In Fig. 1 the graduations are shown, by means of which angles are measured; the graduations being to 30′, which, by the vernier, can be read to 3′ of arc.

In a suitable recess, provided for the purpose, is a steel sliding piece *C* (shown separately at Fig. 4), which may be moved back and forth by means of the small screw *H*, and nut *G*. This sliding piece may be clamped to *A* by the nut *D*, and washer *E*, so that when motion is imparted to the sliding piece *C*, *A* partakes of that motion, and a fine adjustment is had, which, when made, is retained secure from accidental displacement. By loosing nut *D*, *A* can be moved quickly by hand to any desired position.

Nothing projects from either side of the instrument, and it will lie flat upon the paper, either side up. Though graduated for 45° only, any angle may be laid off, because the instrument may be used with either the lower or the right-hand edge of the part *B* against the T-square blade, the graduations being numbered to read angles in both directions, as indicated by the figures.

On one side is a table showing the dimensions and angles of U. S. threads, as shown in Fig. 1, while upon the other side is the table shown below Fig. 1, giving the taper and corresponding angles of the Morse taper shanks, pipe threads, and the angles of the most frequently used geometrical figures.

It will be perceived, of course, that the instrument can be used either as a protractor or as an adjustable triangle; the fact that it can be used either side up making it very convenient for drawing taper shanks, or other objects where it is required to draw lines at the same angle either side of the center line.

The instrument is the invention of Mr. C. E. De Puy, Jackson, Mich.

### Manganese Bronze for Screw Propellers.

*The Engineer* (London) lays great stress upon the important advantages resulting from the use of manganese bronze for screw propellers. It, by implication, attributes the escape of Her Majesty's ship Calliope, from the harbor of Apia, to the fact that her propeller was made of this metal rather than steel or gun metal; for, as it was, she was able to maintain a speed of one-half knot per hour only in making her way out against the storm, the probability being that the propeller of manganese bronze added more than that to her speed in excess of what she would have possessed with a propeller of steel or gun metal.

Numerous instances are given in which decided improvement in speed and economy of fuel have resulted from the substitution of propellers made of this alloy for those made of steel, every other condition remaining precisely as before.

One case is of two vessels plying between Australia and San Francisco, the speed of which was thus increased two knots per hour, the voyage being made in two days less time. The White Star Line have eight ships fitted with these propellers; the Cunard Company, two; the Inman Line, two—the City of New York and the City of Paris. The North German Lloyd Steamship Co. has eight ships equipped with them, and it seems likely that it will come into almost universal use.

The advantages which it possesses over steel seem to arise from the fact of its greater smoothness of surface, and also its freedom from the warping which usually takes place when steel propellers are annealed, and which makes them almost always considerably out of true pitch. Then they are free from corrosion and pitting, and will consequently retain their smooth surfaces. As compared with propellers made of gun metal, they are so much stronger and tougher that the weight can be very much less. Though costing in England about three times as much as propellers made of steel, their superior durability makes them, in the end, cheaper, they being, barring accidents, as long-lived as the rest of the ship.

### Shop Notes.

A very interesting place for a mechanic to visit is the establishment of Ginna & Co., of this city, where they make a great variety of pressed and drawn tin goods, many of which are very tastefully and beautifully decorated by a process similar to ordinary chromo lithographing, except that the printing presses in which the lithograph stones are used are somewhat modified to fit them for handling the sheets of tin instead of paper.

The colors used are a sort of enamel, which is hardened by heating, and much of the work is cut out and shaped, and in some instances even drawn to some extent, without injuring the ornamentation in the least.

Such packages as are used in putting up baking powder, tobacco, spices, etc., are made in extremely large quantities, by processes, many of which are very ingenious and interesting; but the chief interest to the writer was in the automatic machinery for making tin cans, such as are used for packing fruits and vegetables for the market, the appearance of which, as they ornament grocers' windows, and finally as they decorate the back yards, alleys and vacant lots of the country, is so familiar.

The sheets of tin of which the bodies of these cans are made, are first laid by a workman upon a platen and shoved forward, where they are drawn in between two pairs of steel disks having beveled edges, and rolling together in such a manner as to shear from each edge of the sheet a narrow strip, which reduces it to a length just equal to the circumference of the can, plus the amount to be taken up in forming the side seam. After this it passes in a direction at right angles to its former motion through other shear rollers, which simultaneously cut the sheet in strips, the width of which equals the height of the cans. The strips at the same time pass through rolls which straighten them preparatory for forming the bodies.

This is done upon a machine, which, though it differs in general appearance, has motions similar to those of bolt-heading machines, having four plungers moved by cams, which alternately move to and from the center, where there is a sort of arbor, about which the strips of tin are bent to the required form. The attendant lays a strip upon a platen in front of the machine, when it is automatically carried forward under the arbor, and a plunger rises from below, bending the strip upwards at each end around the arbor, into the shape of the **U**. Then two side plungers come in, further bending the ends about the arbor so as to form the complete circle. The ends which have at the same time been turned up so as to hook together and form the seam, are brought together on top of the arbor, and a plunger descending from above presses them together firmly, and forms a very neat seam.

Two hooks then advance and pull the piece off from the arbor, letting it fall into a chute below. All this is done very rapidly, two machines working side by side in each set, producing easily 30,000 cans a day of ten hours.

As they come from this machine a boy takes them and places them upon an endless chain, which is in motion before him. He places them with the seam downward, and they are passed over a trough containing a liquid which prepares the seam for soldering. Passing on they go through a trough of iron in which solder is kept melted by Bunsen burners. The seam passing through this is soldered outside and in, and still keeping on, passes between asbestos brushes, which remove all the superfluous solder, saving about $30 worth of it a day, besides leaving the seam much neater than it would otherwise be. The method of brushing the inside of this seam as the cans pass along is worthy of special notice. There is a bar which is held suspended inside the cans, with its length lying in the direction of their motion. It supports the brush, and is itself supported in position by numerous pins of steel, which are ranged in a row on each side of the bar, and pass through strips of iron which lie along outside of the moving cans. These pins fit into holes which are drilled in the sides of the bar, and are pressed into them by the action of springs. Small levers are attached to the pins, and are so arranged that the cans' bodies, which are at a distance of about two inches from each other, strike these levers as they advance, and withdraw the pins successively from the bar; as soon as a can has passed the action of the spring, forcing the pin into its place again. There are always enough pins in the holes at each side of the bar to hold it in place, and thus it is supported inside the procession of constantly moving cans.

From here the bodies are automatically delivered to a machine which grasps them between two jaws, each of which is a true semicircle; they are thus made to conform to a true circle, and at the same time, from hoppers above there slides down a bottom at one end, and a top at the other, these being simultaneously forced on by advancing plungers. From here the cans are deposited upon a surface which is inclined sideways, along which they are rolled by the action of a moving rope which is pressed upon them. The bottom of the can, which is lowest, is rolled through melted solder, and the can goes on until it reaches a surface inclined in the other direction, where the top rolls through solder in the same way.

They are then carried about the room upon a system of endless belt carriers, and exposed to numerous jets of cold air, which cools them off and prepares them for the testing machine. This consists of a shallow wooden tank, in which hot water is kept, the temperature being maintained at a uniform point.

Through the tank there passes, from end to end, a metallic chain, the links of which are wide enough to receive a can between their two sides. Each link has at one side a flat, round disk, against which the bottom of the cans rest; and at the other side, facing it, another disk, having upon its center a piece of rubber sufficiently large to cover the opening in the top of the can; this latter disk is attached to a stem which passes through the side of the link, and is capable of endwise motion through it. Just as a link approaches the end of the tank, a can is automatically dropped into place between the two opposing disks, and, as the links enter the tank, they pass between two fixed pieces of iron, which lie parallel to the chain and outside of it, being at such a distance apart that the projecting end of the stem which is attached to the movable disk is forced inwards hard against the can, the rubber making the joint perfectly tight. Passing through the hot water, the air within the can is expanded, causing considerable pressure; and if there is a leak it is shown by bubbles which rise through the water; an attendant taking out all cans which show any indications of a leak. By the expansion of the air considerable pressure is put upon the cans, and they are thus very thoroughly tested; it is done very rapidly, and without putting anything more than heat inside of them.

A machine has just been completed, which is to do the testing in a somewhat different manner. It consists of a double wheel about four feet in diameter, and having two sets of arms and two rims, which are round in section. The two sets of arms are tied together by cross-pieces below the rims, and the opposing disks, between which the cans are placed, are inside these rims. Radiating from the hub on one side are small iron pipes, which at their outer extremities connect with a hole passing through the rim on that side, and through the center of the rubber disk which closes the opening of the can. Compressed air at a uniform pressure is introduced at the hub, which is so arranged that only the four pipes which are at the bottom of the wheel are in communication with the air-pressure—these, as the wheel slowly revolves, being shut off, and

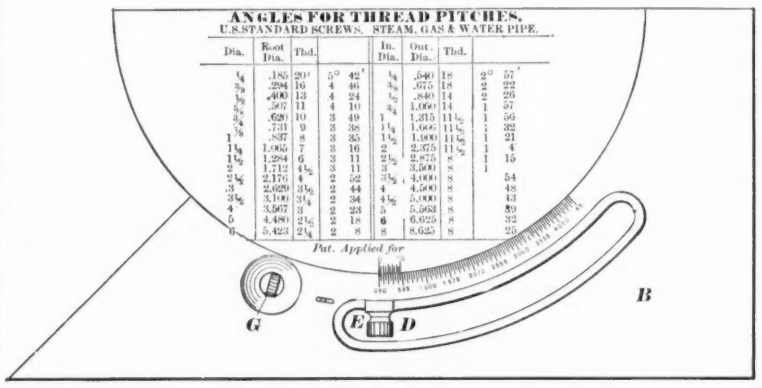



*Fig. 1*

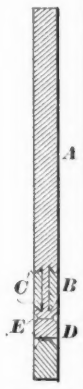



*Fig. 3*

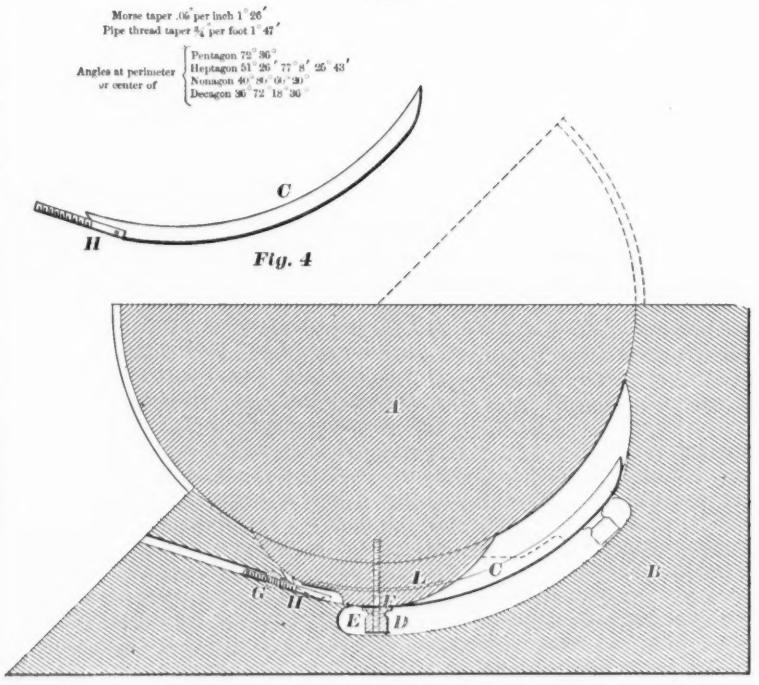



*Fig. 4*

*Fig. 2*

A New Draftsman's Protractor.

others as they come below being put into communication and receiving the pressure. The lower part of the wheel is submerged in cold water, and as the cans are brought into this water, the air pressure is thus automatically turned onto them and shut off again as they emerge from it, bubbles showing in the case of leakage as before. The advantages of this plan are considered to be that the pressure put on is always known, and is uniform, as the air comes from a receiver, the pressure in which is kept at a uniform point by a Clayton Compressor.

The cans are moved about the rooms, and from one story to the other, entirely by endless chain and belt carriers, the work being done almost entirely by automatic machinery from the time the sheets are cut up until the finished cans are deposited on one of the lower floors, ready for packing.

Much of the decorated work made here is made upon orders from European countries; prominent firms even in France, where in the matter of decorative arts they are supposed to be far in advance of this country, ordering their labels designed and made here.

## Improved "Little Giant" Injector.

We give with this an engraving showing the "Little Giant" locomotive injector, in its latest improved form.

As heretofore made there have been two levers standing vertically above the body of the injector; one of these has now been entirely dispensed with, and the other moved from its former place, outside of the stuffing-box, to a position inside of it, as shown; the function and operation of the lever remaining the same as before, but the length of the injector over all being considerably reduced. The other lever, which was used for adjusting the combining tube, is taken off, and its office performed by the screw and hand-wheel shown below, at the left. This screw does not enter into the interior of the injector, but, by means of the two connecting links, one of which is shown attached to a clamp collar, which encircles the combining tube, adjusts this tube, and retains it at any desired point without the necessity for tightening any thumb-screws or other devices, to prevent the adjustment being lost.

Another advantage gained by this arrangement is in the fact that the injector can be worked entirely from the end nearest the cab. In this design the distances between the various pipe connections have been made to conform to the standard, so that the injector will interchange with others.

The makers are the Rue Manufacturing Co., Philadelphia, Pa.

## Shop Notes.

BY JARNO.

No. 15.

DESTRUCTIVE WELDING—ARBOR CENTER HOLES—NECESSARY ACCURACY.

I use the words destructive welding as a term for the unintended uniting of one piece of metal to another, when they are rubbed together as in the parts of a machine. Waubug Mephit says: "This is not a good term for that which machinists call roughing, or sticking; moreover, a new term is not needed, as the old ones are good enough. Welding properly means the heating of two pieces of metal, almost to fusion, and then pressing or beating them together. To extend the meaning of the term to other things is not warranted."

Craig said to Mephit, "The uniting together of two pieces of horn or tortoise shell, after being softened by heat, is called welding. This is already outside of your meaning, as horn or shell is not a metal. Some years ago I saw a description of a method of uniting two pieces of metal by rubbing them together under pressure, without previous heating, which was called cold welding. It would appear that your idea of the term is not broad enough, as, in general, to unite any two solids directly together, without fusion, is called welding." Mephit still insisted that welding means solely the heating and hammering together of two pieces of metal. Craig then asked whether the welding of two people together in friendship consisted in heating and hammering. Mephit did not want to hear any more; he said that such a question lacked dignity and courtesy.

Gascon says, "It is quite ludicrous to see a man attempt to skulk behind his dignity or gentility, when he has not enough of either quality to fit out a small-sized boy. Abrasive welding would be a good term for the sticking of one piece of machinery to another, because what is welded to one part is abraded or taken from the other part."

Whatever it is called, the thing itself is something that most machinists would like to know less about. In the whole range of a machinist's experience there is nothing more vexing than the delay, or more troublesome than the injury it causes. Most that he knows of it was learned in sorrow. One of the best remembered lessons in destructive welding was learned in fitting a face plate to a lathe spindle. The plate appeared to fit quite well, and went on easily enough, turning by hand, until it was nearly up to the shoulder. Suddenly it went hard, and then would go no farther. This was a surprise. There was a greater surprise when an attempt was made to take off the plate. Benzine, oil, a long lever with heavy pressure were applied to the plate in order to get it off, but without avail. Destructive welding had done its work, and it was necessary to complete the work of destruction with a sledge on one side of the plate, and on the other side a cold chisel backed up by a hammer. The plate being of cast-iron, oil was not put on the thread, so that, if another chip had to be taken, the tool would take hold as well as at first. I think that all might have been well had there not been blow-holes in the hub of the plate. These held dust and chips from the threading, which aided in the welding. It is not a feeling of modesty that prompts me not to give the name of the man who worked on this plate.

"LITTLE GIANT" INJECTOR.

A soft-steel lathe arbor driven into anything made of soft steel, is liable to weld. Sometimes a hardened arbor will weld into soft, and occasionally into hard steel. I am told of a hard shaft and a hard bushing that were oiled and wrung together by hand; in driving them apart, both were spoiled.

Hard soap rubbed upon an arbor and in a hole is a better preventive of welding than oil. When abrasive welding has once taken place, every bunch must be completely removed; unless this be done the trouble is very likely to be repeated.

Craig was at one time a foreman for Gascon, and together they made an interesting pair. I do not say that Craig ever drew from his imagination when facts failed, but I do assert that he had a convenient memory, and a facility in supplying any story with the minor points that had been left out by Gascon. The details of a story that had been passed by both of them were well worked out. I once asked Craig whether he had ever known of the welding of a center into the center hole of an arbor so that the center left its body and went with the arbor. He answered that he had known this to happen. "How did you know it? Were you near the arbor when the welding took place?" Hesitatingly he replied, "Well, yes, somewhat near, but not quite so near as I ought to have been."

I once saw sparks drop from the center in a lathe near which I was standing. Had this center stuck into the arbor, I think the operation would have been near enough to welding to have satisfied Mephit, for the red sparks must have resulted from considerable heat, in consequence of pressure in the place from which they came.

When the end of a center is thus welded into an arbor, it is very hard to get out, generally requiring to be heated to redness before it can be removed. Mephit tells that he and other machinists in the shop once allowed a man, who was not a machinist, to go on polishing in a speed lathe until the end of the center came off, and the arbor flew across the shop. Gascon would like to make these machinists run speed lathes, without oil, for a sufficient time, and then compel them to pay damages, and read to each other from the first chapter of ethics.

When we consider the heavy duty of center holes, even under the most favorable conditions, we appreciate the care required in making and using them.

If we calculate their surface pressure in legitimate use, we shall find it many times greater than would be considered safe in designing a machine. Added to this pressure there may be another that is still greater, coming from screwing up the center too hard, and from expansion of the arbor by heating. If, after the center is just tight, the arbor heats, the end pressure is limited only by the strength of the lathe bed, or the power of the arbor to resist compression. This is something enormous, and trouble therefrom may come upon any machinist who wanders from his lathe, and is in consequence not quite so near to it as Craig said, that he "ought to have been." It is well to have center holes countersunk to the correct angle, and as large as is consistent with strength. These two things will lessen the risk of cutting, though nothing will take the place of care or "nearness" on the part of the workman who runs the lathe. The hole at the bottom of the countersinking need be only large enough to use a fair-sized drill. Many arbors nowadays are hardened, and here we have another difficulty, which is that the center holes may be changed. Mr. J. F. Ross tells me that from long practice he has learned that it is best to countersink the center holes from a half to a whole degree more acute or sharper than the finished holes are wanted after hardening. In hardening the arbors the greater expansion at the end brings the holes about to the correct angle. After hardening, the holes should be lapped. We cannot be sure of obtaining the most accurate work, when turned upon an arbor, unless the center holes are axially true with each other. Though lapping tends to true the holes, yet I fear that no practical amount of it will make them quite true if the arbor be much crooked in hardening. In manufacturing arbors I think it would be well to lap both holes at the same time.

Wanderon tells me that, in conversation with two professors in the Jefferson Physical Laboratory, the question was asked, he thinks by Prof. Trowbridge, "Is there anything made in a machine shop that must be to within the one ten-thousandth part of an inch of exact?"

If I were requested to answer this question, I would say that most machinists sometimes work to this limit, and that it is sufficient to make the difference between a light and a loose fit. This is not quite an answer to the question, because, in most cases, the limit can be allowed in one direction. For instance, the crank-pin of an engine cannot be any too small, but it can be even one-thousandth of an inch larger than necessary, and yet be successfully shrunk or pressed into the crank. I think it is generally understood that rolls used in making paper must be within .0001" of exact. The adjusting of paper rolls, I understand, is also a matter that must be within the limit named, for, if the paper were .0001" thicker at one edge than at the other, it would, when wound into a roll two or three feet in diameter, make the roll larger at one end than at the other, and the paper could not be used in some printing presses. I should think that a phonograph, or a graphophone, of which so much is expected, would have to be made with great accuracy. It is promised that a cylinder, upon which is recorded what was spoken in one machine, can be sent thousands of miles by mail, and be put into another machine, which will tell what is recorded upon the cylinder. As the width and depth of the impressions upon the cylinder may at times be hardly .001", it would appear that some parts of these machines must be within the limit named. Of course, a standard plug and ring are expected to fit each other to within .0001", and a micrometer caliper that purports to measure to this limit should be correspondingly accurate; but the necessity for their accuracy rests, in the last analysis, upon the requirements of the work they are to test, which is really what the professor meant. I am unable to give a strictly definite answer to his question.

## LETTERS FROM PRACTICAL MEN.

### "Soft Castings."

*Editor American Machinist:*

"The reason we prefer to have you make our castings is, that they are so much softer than those we get at other foundries—the reason for their being so soft is, that you print our patterns back in the sand."

The above remark was made to the writer the past week by the senior member of a manufacturing concern using castings to a very limited amount. At last, at last, we have the solution of the hard casting question. Use any grade of pig, scrap or burnt grates in any proportion, melted at any heat, and poured into sand, no matter how damp; but be sure before pouring to "print the pattern," and you will be charmed and delighted at the results obtained.

We have not tried the scheme as yet, so are not quite prepared to endorse, even at limited amounts.

It is daily becoming more apparent to me that the men who have rammed their way through the core room and foundry, and have reached the thankless position of foreman, should retire from active participation in the daily heat, to make way for the brilliant intellects of men who, with no experience whatever, can suggest such simple and inexpensive methods to ensure "soft castings." "GRANGER."

### How Natural Laws are Annulled.

*Editor American Machinist:*

The whole tower could be lifted by four men of average strength. The case has been proved. When it was about half its present height, a few men actually did lift it. This

is not humbug; the thing is perfectly simple. The construction of the tower is based on the cantilever principle, and its bulk of 6,400 tons is so adjusted as to press on the foundation with less weight than that of a man in an arm-chair on the floor.

The above I clip from the *Baltimore American*, credited to Emile Michelet, in the *Paris Illustre*. The article from which I clip is entitled "Eiffel Tower Comment"; unless I am a little off, the writer is a little wild.

He states the total weight of the tower as 6,400 tons, and I generally understand (in round numbers) that a man sitting in a chair represents, say 200 pounds. What I cannot see is, where the remaining 6,399 tons and 1,800 pounds have gone to, unless the law of gravitation is reversed in France.

The statement of the clipping true, then supposing we had an engine weighing 6,400 tons to ship by freight (railroad), then it would follow that, in order to reduce the cost of freight, all that would be necessary to do would be to construct the engine on the "Cantilever principle," and we could ship the total engine for 200 pounds. Engine builders behind with their orders might ship by express, instead of using say 200 railroad cars, as we now do for this weight.

It appears to me that this description is of the same family as the usual "Cause of Boiler Explosions," "A Large Locomotive," etc. F. A. P.

Waynesboro, Pa.

### Drawings for Pattern Makers.

*Editor American Machinist:*

The purpose of the writer in discussing this subject has been to suggest what was thought to be the best plan, and if it was not such it would call out the views of men experienced in that line, and thus finally arrive at the most practical plan. As Mr. Dingey and Mr. Hultgran have kindly criticised a part of the plan advocated, I desire to make some acknowledgments, and also to try and fully understand Mr. Dingey's criticism.

I am not a practical pattern maker, and therefore it is quite possible that I do not fully understand pattern making; but I have had considerable to do with having patterns made to order from drawings furnished, and have learned what little I know about it from observation of the process.

I cheerfully admit that I was wrong in inferring for an instant that if a pattern maker was furnished with a full-sized detail drawing, that would be all that was needed in the making of the pattern. This, then, reduces the plan I advocated, to merely the question whether it will pay to make a special drawing for the pattern maker. To answer this it is necessary to know what kind of a drawing he would otherwise have to work by. The general system of drawings for shop use that I advocate has the following features: All detail drawings for machine and blacksmith shop to be of one size, the outlines of the drawing not to exceed 13″x18″, and maybe less. The object of this is economy in space occupied in storing and using them, and ease of finding them in a drawer or rack, and above all to make them self-indexing by having a drawer for each size of machine and keeping all the drawings of that machine in it, the drawer being simply marked outside with size and name of machine. Machine shop drawings to have marked on them all and only such dimensions as are needed by machinists to finish to, because it is a great disadvantage and loss of time for most machinists to have to pick out the sizes from among a lot of figures that would never be used by any one of the workmen, except the pattern maker, and it is certainly very bad economy to confuse the machinist by unnecessary and to him worse than useless figures on a drawing that may be used hundreds of times, for the sake of using the drawing once in the pattern shop. A scale drawing with all the dimensions on it that a pattern maker would need contains usually about four times as many dimensions as are needed on the machine shop drawing of the same piece. I know from experience that to give the pattern maker the machine shop drawing to make the pattern by does not pay, because it results in too many mistakes being made. I think now it can be seen very readily why I advocate as a part of the general plan that special drawings be made for the pattern shop.

In one shop where I was once employed they made drawings for pattern shop full size, and with all allowances made for shrinkage, draft and finish; but the head draftsman was the real foreman of the pattern shop, though one of the proprietors was nominally foreman. This worked exceedingly well in that case; but I am aware that if there is a boss pattern maker with the dignity of his position to maintain, he might sit down on the plan.

Generally speaking, then, it will be best, where there is a competent foreman pattern maker, to furnish him with a drawing, showing him all the dimensions and shape the casting is to be when finished.

There are, however, some good reasons for making such drawing full size. It is the only way I can conceive of showing the pattern maker the shape of irregular curves. Of course most of such curves may and ought to be, if possible, made up of parts of circular arcs, with the length of radius and center of circle shown; but where that cannot be done then a full size drawing is indispensable. If the drawing is to a reduced scale the pattern maker will have to make a full-size drawing with two or three views of it; but if it is full size he is generally content to make one or two sectional views of it. If a pattern is wanted in a hurry, and he has a full-size drawing given him, it is usually near enough right for him to get out most of the stuff and glue it up so that it can be drying while he is making his drawing. I do not object to the pattern maker making what drawings he deems necessary, but I do object to the crude and expensive way in which they are usually made; and if it must be done I see no reason why it should not be done with appliances as suitable as the draftsman is allowed to have to do his work with.

I have had the best success by making when convenient, full-size pencil drawings on cheap manila paper, giving enough different views and sections to show the shape fully, showing only such holes as are to be cast in, shading in the sections free-hand with a blue pencil, drawing the outlines of parts to be finished with a red pencil or red ink, and giving *all* dimensions in figures, being particular to give the radius and location of center of all circle arcs. The pattern maker is instructed to make his own allowance for shrinkage, draft and finish. By the above plan I can send the drawings to the pattern shop and not be asked a single question about them, as they are so complete that the pattern maker can fully understand them, and get out a pattern that will make the casting wanted; while with all the old plans used, the designer is continually being called on to explain what the drawings fail to show the pattern maker. B. Crank.

*Editor American Machinist:*

Upon reading the articles by "B. Crank" in the American Machinist of March 21, there are some things that are not clear to me.

First: When the drawing given to the pattern maker is made to scale, and the dimensions all put on, does he go on to say, allow for shrinkage and draft? Pattern makers work to shrinkage rule, and if they work to figures, why need they make a full size drawing on board (planed off for that purpose)? If the casting has ports to be planed to fit some other casting, the drawing may be worked enough larger at that point. On castings weighing a ton, $\frac{3}{16}$″ is what I allow to fit on, and I always have enough stock. The pattern maker allows his own draft without being told, and we have no trouble in understanding each other. The pattern maker paints the core prints red, and the moulder understands it. I dot the outline of the cores with red ink, and the pattern maker understands that.

I am not an M. E., but a machinist.

G. W. Bradley.

### Pressure on Valve Disks.

*Editor American Machinist:*

The articles and opinions advanced in your valuable paper are, as a rule, so correct that it is rare to find in your columns a statement, the accuracy of which may be called in question.

In Mr. Peter H. Bullock's article on "The Modern Steam Plant," in your number of 21st March, with reference to the trouble one has with leaky stop valves, he states that, with his ingenious mode of measurement, he found that, on screwing the valve down on its seat with the hand-wheel, a pressure of 1,500 lbs. was got on the joint, that the area under the joint exposed to the pressure was 13 square inches, and the pressure of the steam was 90 lbs. per square inch, making 1,270 lbs. (we will retain this amount, although 1,170 lbs. would be more correct), and that this would make a total strain on the joint of 2,770 lbs.

Now, is not this an old fallacy brought forward in a form that makes it more difficult to realize the truth than in its old dress, when it used to appear as the total strain on the bolts of a cylinder cover, when a certain force had been exerted in tightening up the nuts, and steam was admitted into the cylinder?

Perhaps the clearest way to put the case is as follows., Let us suppose that the cover is not fastened down in any way, but we will arrange weights around it to the amount of 1,500 lbs., thereby just making the joint of the cover tight; now let the steam be admitted, the strain on the joint due to the steam being 1,270 lbs. The cover will not be lifted, as it is already weighted to 1,500 lbs., and the joint will be just as tight as before; the truth being that the strain on the joint is only that of the greatest pressure exerted on it, whether that be due to the pressure of steam within the valve-box, or is the effect of screwing down the valve with the hand-wheel. Therefore the real strain on the joint is only 1,500 lbs.

Charles de Grave Letts.

Genoa, Italy.

[We think our correspondent hardly makes his case. Mr. Bullock says, in the article referred to "making 1,270 (1,170) lbs. on the joint before any more was put on it by the wheel and stem." This makes it plain that the pressure was top of the valve, acting to hold it to its seat. If then, in addition to the force with which the steam holds the valve to its seat, we add the pressure exerted through the screw, it seems plain that the total pressure will be the sum of the two pressures, as Mr. Bullock has it. The case of the cylinder head is quite different. There the bolts are holding the head to the joint, against the tendency of the steam to force it away.]

### Wooden Pump Packing.

*Editor American Machinist:*

Where I am employed we have a battery of three boilers that furnish steam for the engine, and for heating. To supply the boilers with water we use a No. 3 Blake single-acting pump. We had trouble with the water end; could not keep it packed. We take water from a heater, and at times it is so hot as to melt the packing. This trouble had existed for some time; we had tried all kinds of packing in the market, but without success. Finally I took a piece of white wood, 1¾-inch thick, and turned up a disk to just fit the bore of pump. I soaked this in linseed oil for three days, and then put it in the pump. This was on the 8th of January last, and up to this time we have had no further trouble. We take off the head and look at it once in awhile, but have never had it out, and it appears to be as tight as when put in. We have hose attached to the pump, and throw water over the roofs in dry weather.

This may not be new; I don't know. I do know it is good, and it may help some one in similar trouble. If so, it will help to pay for many useful things for which I am indebted to the American Machinist.

A. W. Davis.

There are about six hundred vessels in the British navy.

### Physical Terminology.

By W. H. Booth.

The study of heat, as it concerns the steam engine, offers some little difficulty to the young student, owing to the somewhat complex interchangement of the different manifestations of heat in reference to pressures. The thermometric intensity of steam at atmospheric pressure is 212°, whilst at the absolute pressure of 100 pounds per square inch its temperature is 328°. The total amount of heat in a pound weight of steam at the higher temperature is nevertheless but very little greater than the total heat in a pound at the lower temperature. The reason of this is that, as the temperature of steam increases—that is, as its pressure increases—its latent heat decreases. Why is this? The reason is as follows: A pound of steam at atmospheric pressure occupies a volume of 1,642 times that of a pound of water. At 100 pounds pressure the volume of a pound of steam is only 270. Now it was in the expansion of water into steam that steam required latent heat to enable it to fill the immensely increased volume. Similarly, by compelling a pound of steam to contain itself in a capacity of 270, where it would fill a volume of 1,642, we enable it to exist as steam with a less quantity of latent heat than it would otherwise require. Thus, an addition of sensible heat has served to squeeze out, as it were, some of the latent heat. This principle is well illustrated by forcibly compressing air in a long tube by means of a tightly fitting piston. If rapidly compressed, the closed end of the tube will be found sensibly warmed.

This experiment may equally well be looked upon as a conversion of work into heat. The sensible heat is evidence that the heat latent in the tube full of air, and necessary to that volume, is given up when the volume occupied is reduced, and so it is with steam at varying pressures. From this it may be argued that the *total* heat in steam of any pressure should be a constant quantity. As a fact, the total heat gradually increases with increase of pressure, or the addition of sensible heat does not set free its full balance of latent heat. This discrepancy seems to be due to the fact that steam is not a perfect gas, as certain gases are usually considered, which will not liquefy excepting under great pressure. Therefore, not being a perfect gas, any increase of pressure is a step toward liquefication, and a portion of the added sensible heat is called upon to counteract this tendency, and thence arises the slight increase in the total heat as pressures increase, this increase being simply that necessary to prevent condensation. It is, of course, to its latent heat that steam owes its powers of expansion and of performing work. When steam expands against a resistance it becomes cooler; a portion of its sensible heat disappears and becomes latent, for the purpose of enabling the steam to fill the increased volume. A portion of the steam disappears entirely as steam, and is re-converted into water. In this re-conversion it gives up its latent heat, which is directly converted into work. At the same time, also, any water which was present with the steam at its original temperature will be too hot to exist as water when the pressure falls. A portion of this water becomes steam. To exist as steam, it borrows some of its own sensible heat for which it has no need, and it borrows the surplus heat of the water which does not become steam, and it borrows heat from the walls of the vessel containing it, as from the internal surface of the cylinder in a steam engine. All these interchanges of heat take place rapidly, and continue until a balance is attained. It is due to latent heat that the presence of water in the cylinder of a steam engine is so hurtful economically; for the water has carried heat from the boiler, but brought with it no power of expansion, and is therefore only a clog on the proper action of the steam; for it absorbs heat at a high level, and gives it out as work at a lower level, and, unfortunately, much of the lower level is during the exhaust stroke, when the tardily exerted expansive action takes place against

the piston motion instead of with it. This is the great argument against moist steam and initial condensation in the cylinder, and serves to explain why it is that, with excessive amounts of water primed over from the boiler, a steam jacket may do more harm than good.

In contact with water there is, for steam, a fixed pressure corresponding to every degree of temperature. The ratio is fixed and invariable, but it is curious that, by mixing salt with the water, the pressure of steam made therefrom is less than the steam in contact with fresh water. Thus, salt appears to increase the molecular cohesion of the water, and this is the more curious that at a low temperature it has the opposite tendency, and assists to increase the molecular vibration of ice, which it converts to water. Salt has thus the power of modifying the two great transformations which water undergoes under the influence of heat—it assists heat to produce water from ice, but retards its action in converting water to steam. No satisfactory explanation of this curious action has been given.

The latent heat of water, or the heat which disappears when a pound of ice at 32° becomes water at 32°, is 142.65 thermal units.

When a pound of water at 212° becomes converted into steam at 212°, there disappears as latent heat 966.6 thermal units. This is very often termed the heat of evaporation. The last figure is the latent heat as determined by Regnault, the best recognized experimenter. Andrews fixed the amount at 964.6. Regnault's figures are, however, usually taken as the engineer's and physicist's standard, and adding the boiling temperature of 212° gives the total heat in steam as 1178.6° at the pressure of one atmosphere.

James Watt drew the conclusion from his own experiments that the same weight of steam at all pressures contained exactly the same amount of heat. Any discrepancy that he observed he doubtless put down to experimental errors. It remained for Regnault to show that the conclusions drawn by Watt were not absolutely correct. He showed that the sum of the sensible and latent heat increases with rise of temperature by a small but constant quantity, which he determined with an accuracy not since shaken or disputed, as .305° of a degree for each degree rise in thermometric temperature.

Though water is of so much greater specific gravity than alcohol, the vapor of water which boils at 212° is little over a third as dense as the vapor of alcohol, and is of more than three-fold the volume per cubic inch of liquid evaporated.

As the expansive force of vapors depends on the specific volume or proportionate expansion of vaporization, water has proved as economical for heat engines as any other liquids of less specific gravity as liquids.

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It is generally estimated among English builders that if an iron vessel cost $48.60 per ton, a steel vessel would cost $46.56 a ton of her dead weight of her carrying capacity. There is not at present any very great difference in the price of steel and iron ships; but the superior quality of steel ship plates gives them decided advantages over those built of iron.—*Maritime Reporter.*

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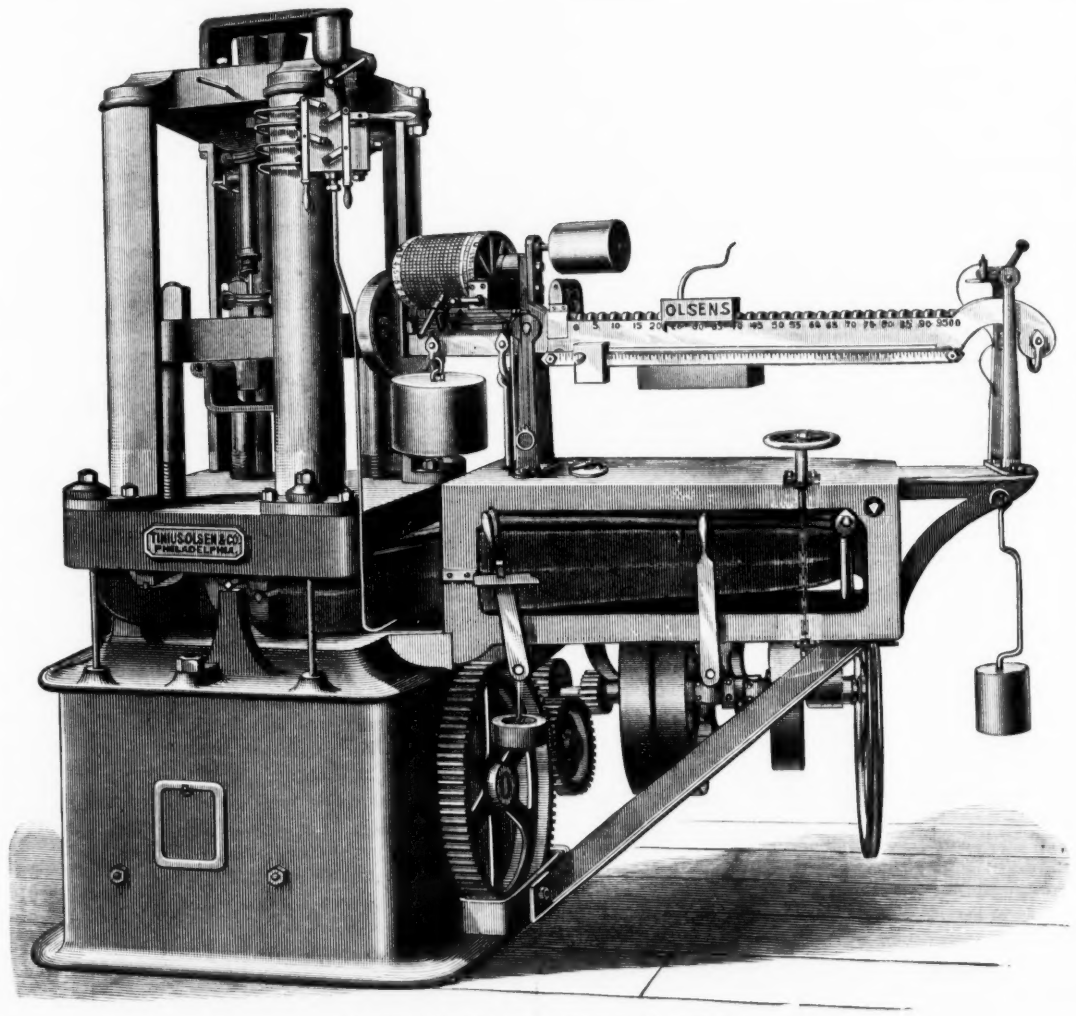
No light was thrown upon the old question as to the influence of air pressure in increasing the adhesion of a belt, by the discussion of Mr. Smith's paper on "Tractive Force of Leather Belts on Pulley Faces," at the Erie meeting of Mechanical Engineers. The opinions as to whether or not the air had any effect were, so far as expressed, just about evenly divided.

## Olsen's Automatic Testing Machine.

In the illustration is represented the latest and most improved form of the Olsen testing machines, as built by Tinius Olsen & Co., Philadelphia, Pa. The essential devices of a machine for testing a sample of material are its straining mechanism and its weighing apparatus; also the tools for holding the samples, and the mode of recording the stress and determining the influence of the same on the sample operated upon. These make the machine more or less able to fill the requirements of a first-class testing machine.

Taking a sample of material for tensile test to a machine as illustrated, it is secured by proper tools, one end to the extreme upper plate of the machine, and the other the lower end, to the plate immediately below it, exposing that part of the specimen between them on which the strain is exerted. The lower plate or crosshead is secured to four straining screws, which pass through holes at the corners of the weighing platform of the machine, through openings in the levers and bed-plate, and enter the driving nuts situated below the latter; feathers fitting into longitudinal slots cut through the threads of the screws, preventing them from turning. They therefore either rise or fall, carrying the lower plate with them as the nuts are rotated. These nuts are, through bevel gearing, operated by outside spur gearing and countershaft, which is readily observed at the lower right corner of the cut. The countershaft is provided with double cone and friction pulleys, admitting of six downward or pulling speeds, and two upward speeds.




Olsen's Automatic Testing Machine.

For tensile tests the ends of the specimen are secured to the plates by steel wedges, which enter rectangular openings cut through the centers of the plates; interposed in the space between the wedges proper and the plate, are spherical surface bearings, by which the wedges are adjusted to the specimen, and the specimen is adjusted centrally, and on a parallel line to the line of greatest stress, and a straight pull secured.

The weighing apparatus consists of the main levers upon which the platform sets, three in number, but so constructed as to act as a single lever, supporting the platform, upon which rests the columns which carry the upper plate or crosshead. As one end of the specimen is secured in the upper crosshead, any stress imparted to the specimen by the lower straining head will be communicated through the columns and platform to the levers. The stress on the main lever is, through an intermediate lever, communicated to the beam, where the amount is balanced and registered. The stresses in this machine are automatically balanced on the beam; this is accomplished by means of a coarse-threaded screw being placed on the top of the beam, the sliding weight being moved by this screw. At the end of the screw, and also the extreme end of the beam nearest the machine, is secured a wheel, by which the screw is operated. A small friction pinion is fitted into a groove in this wheel. The pinion is continually running, driven by a belt from the countershaft. In order to make connection between the pinion and the wheel, the pinion shaft bearing is mounted on one end of a lever, the other end being controlled by an electro-magnet. The electric circuit from a cell is connected or disconnected by the vibration of the beam. Thus the raising of the beam makes electric connection, charges the electro-magnet which attracts the lever, and thus throws the friction pinion into contact with the wheel which revolves the screw and moves the poise out. When the beam drops, the electric contact ceases, and motion of the poise stops. This arrangement simplifies the testing, as the attendant may look after his calculations or measuring while the specimen is pulled apart, thus saving much time. The wheel at the end of the screw, besides operating the screw, also serves the purpose of a dial vernier for reading the smaller fraction of the stresses.

In addition to the above described automatic motion, the machine is provided with means by which the machine itself will record graphically the result of the test. In order to do this, the distortion of the specimen under test must not only be observed, but transferred to a piece of paper which is mounted on a drum on the beam, in front of which is seen the pencil for marking the diagram. The pencil is moved axially along the drum by the same screw which moves the poise on the beam, and thus this motion indicates the stress on the specimen.

The rotary motion of the drum is made to show the distortion of the specimen as follows:

On the specimen are secured heads, say 6, 8 or 10 inches apart, the distance in which the distortion, or in case of tensile tests, the elongation, is to be observed. Between the heads are placed small cylinders, partly filled with water; a similar cylinder is placed on the beam in front of the drum. These cylinders are then connected through a collector and reservoir shown at the top of the engraving, by the use of which the arrangement is controlled and operated. The drum carrying the paper is connected directly with the cylinder in front of it, and, when all is properly adjusted, any expansion of the cylinders and their pistons on the specimen, caused by its elongation, will cause a corresponding contraction of the cylinder and piston in front of the drum, and this motion is transferred to the drum on which the line is drawn. This line is drawn on properly lined paper, so that the result of the test, viz., tensile strength, limit of elasticity, elongation and other ways, the nature of the material can be observed by a glance at the diagram.

From the foregoing, it will be seen that this machine is very conveniently operated. We are informed that, in its improved form, several of them are already in operation.

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A new process of hardening plaster so as to make it available for the construction of floors in place of wood, has been brought before the French Academy of Science by M. Julte. A mixture of six parts of plaster of good quality and one part of finely sifted, recently slaked white lime is employed like ordinary plaster. After it has become thoroughly dry, the object manufactured from it is saturated with a solution of any sulphate whatever whose base is precipitated in an insoluble form by lime. The sulphates especially recommended for the purpose are those of iron and zinc. In order to obtain the maximum of hardness and tenacity, it is necessary to temper the limed plaster well in as brief a space of time as possible, and with no more water than is strictly necessary.

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Railroad accidents are universally regarded as unmixed evils; but that a lucky, and fortunate, and well-timed accident is possible was happily shown in Kentucky a few days ago, when an axle broke in the freight train which was carrying to Chicago the materials of Libby Prison, which were there to be re-erected for a public show. As the result of the accident, the materials have been mostly appropriated by curiosity seekers, and are so thoroughly dispersed that we shall be spared the vulgar spectacle, against which patriotism and decency alike revolted.

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It will be remembered that, a year or two since, Edward B. Dorsey read a paper before ths American Society of Civil Engineers, in which he made comparisons between American and English railroads, which excited a great deal of newspaper discussion Mr. Dorsey is now in South Africa, in the interest of an English syndicate of railroad constructors.

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Professor F. E. Nipher has been making some experiments, an account of which he recently presented to the Engineers' Club of St. Louis. One of his conclusions is that the friction of an engine is constant at all loads, provided the speed is constant.

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The *Boston Journal* says: It used to be a schoolboy adage that "whatever goes up must come down." The application of this axiomatic principle to the price of copper is what is at present troubling the producers of that metal.

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NEW YORK, MAY 30, 1889.

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## The Mechanical Engineers at Erie.

The recent meeting of the Mechanical Engineers at Erie, to which we have previously referred, was a pleasant one, and no doubt it was profitable to those who attended. The attendance was not as large as it would have been had it not been for the fact that so many of the members were to take the European trip, and hence were busy getting their business in shape to leave. There was, however, a very fair attendance, and the interest was well maintained.

As usual, there was considerable time given to excursions and receptions; in fact, the growing interest of the people—manufacturers and others—in the society was emphasized at Erie; either this or the citizens are more than ordinarily hospitable. One thing appears certain: they are proud of the manufacturing interests of their city, and fully appreciate the work of manufacture in building up its prosperity.

As usual, the time for the work of the society was too short, and the discussion of the papers not so full as it would have been if members had not appreciated the fact that there was too much work for the hours that could be devoted to doing it. The lack of time was particularly noticeable in the instance of "Topical Discussions," most of the questions propounded remaining untouched at the close of the meeting. These questions are an important feature of the meetings of the society, because nearly every member is interested in them, and most of the members have had some experience in relation to them. The questions are always of a mechanical or engineering nature, and their impromptu discussion, in which so many take part, is always interesting and instructive.

Discussions of papers will be sent to the secretary, to appear in the Transactions, but this is by no means so satisfactory as discussions on the floor; as the practice of discussion only in the Transactions increases, members are likely to see less occasion for attending the meetings, and the attendance will suffer accordingly. Before long the propriety of presenting fewer papers, and having a fuller discussion of those presented, is likely to come up.

Secretary Hutton is to be commended for his action in preventing a mechanical bazaar being made of the rooms occupied by the society. He had considerable work of this kind to do at Erie, and he did it so courteously as to give no cause for offense. It is the custom of some societies to permit, and even encourage the bazaar feature, and it is not to be wondered at that salesmen anticipate the same privilege from the Mechanical Engineers. This custom has proved not only annoying, but damaging as well, to other societies, and the secretary is acting in the best interests of the members in discountenancing it before it becomes a nuisance.

## Sunday Work.

It is gratifying to note that there is quite a general movement among the railroads and street car lines, looking to the reduction of Sunday work to the lowest possible limit, and doing away with it entirely wherever the nature of the case will admit. The question of Sunday work has, of course, a moral side, and it is that side which most strongly influences many who are striving to lessen the evil. But, aside from the moral and religious side of the question, there are many convincing arguments against requiring men to labor continuously and without intermission, or with periods of rest only at long and irregular intervals.

Physiologists are universally agreed that men need, for purely physiological reasons, one day's rest out of the seven, and in every instance where there has been an opportunity to make a fair comparison between the results of the labor of men who worked continuously every day, and those who rested one day in seven, the showing has been favorable to the latter. In this connection the president of the Delaware & Hudson Canal Company's Railroad is quoted as saying that they "have not for years turned a wheel on Sunday . . . simply because we can get more and better work out of our men in six days than we can in seven."

There is plenty of evidence upon this question, all pointing in the same direction, and the conclusion is inevitable that the almost universal desire of workmen for rest on Sunday, and their strong objection to working continuously every day, is the result of a natural physiological law, which, like all other laws of the kind, cannot be violated without some one having to suffer the penalty. And it is not likely that the workmen suffer all the penalty, either; employers and the public suffer quite frequently.

There is good reason for believing that many railroad accidents are directly traceable to physical and mental exhaustion of trainmen, caused by the strain of severe and exacting duties, performed without relaxation for a period of time beyond that which is allowed by nature. And in the case of street railway employes, who are required to work from twelve to sixteen hours every day, Sundays included, it is probable that society suffers, and will suffer, a large share of the penalty. For the presence in the community of a considerable body of men to whom civilization means almost, if not quite, nothing, upon whom society has imposed burdens almost intolerable and infinitely heavier than are imposed by nature as a condition of living—we say that the presence of a body of men living under such conditions is a menace and a danger to republican institutions. It is especially necessary, if the experiment in popular government undertaken here one hundred years ago is to prove a success, that our citizens should have time, opportunity and encouragement to cultivate the moral and intellectual faculties which distinguish men from mere brutes; and those who deny that the common people will take advantage of such opportunities to improve themselves, in effect deny the possibility of the continued success and permanence of our form of government.

## Lucius W. Pond.

Lucius W. Pond, the well-known machine tool manufacturer, of Worcester, Mass., died in that city, May 21, at the age of sixty-three years. Mr. Pond was born in Hubbardstown, Mass., and at twenty years of age went to Worcester and learned the machinists' trade. He was one of the pioneers in the business of manufacturing machinists' tools, and was the founder in Worcester of the business which has since been moved to Plainfield, N. J., and is known as the Pond Machine Tool Co., and also of the L. W. Pond Machine Tool Co., of which he was at the head at the time of his death. Mr. Pond's life has been an eventful one, and not without its times of serious difficulty and trouble, the particulars of which were very generally referred to at the time of their occurrence.

It is no small testimonial to his character to be able to say that before his death he lived down those troubles, and died universally esteemed and respected by the people amongst whom his life had been spent, who were best acquainted with him, and best able to judge of his real value and worth as a man and a citizen.

## A Novel Engine Lathe.

On our first page of this issue we publish an engraving of a lathe which seems to depart from the stereotyped forms as far as it would be possible to depart from them, even if such departure were, for its own sake, made a prime object. Almost every feature of this tool differs radically from the usual forms, and we think a study of the details of its construction will prove both interesting and instructive to mechanics and others interested in such matters; we have, therefore, arranged for the publication of descriptive articles, accompanied by engravings made from the working drawings, and showing all the details. The articles have been written by Prof. C. I. King, under whose supervision the lathe was constructed, and, we have little doubt, will meet with appreciation by our readers.

## Literary Notes.

A POSTAL DICTIONARY. Being an Alphabetical Handbook on Postal Rates, Laws and Regulations, for all who use the Mail. Compiled from Official Sources by Edward St. John. Published and sold by the *Evening Post*, New York.

This little book of 94 pages contains exactly the information that all who use the mails should be in possession of. It tells what can and what cannot be sent by mail, how to send it, and what the cost will be. It should be in every counting room and office, and in every family that patronizes the post-office. The price is only 15 cents.

London *Engineering*, in its issue of May 3 (which is greatly enlarged for the occasion), contains more than ninety pages of engravings and descriptive matter relating to the Paris Exhibition. The illustrations, of which there are literally hundreds, represent in detail the exhibition buildings and their surroundings, and the text is masterly in its completeness. Altogether the effort of *Engineering* to give its readers complete information relating to the exhibition up to the time of its publication, represents enterprise we have never seen equaled in journalism of its kind.

*Mechanical Technology of Machine Construction* is the title of a new book published by Mr. Jno. J. Flather, of Bethlehem, Pa., instructor in mechanical engineering in Lehigh University. Prof. Klein is given as the author of the work, and we are informed that it has evolved under him, and that he has used it in other and various forms for some years past, though its present arrangement and much of the matter is due to the publisher. The book, which is 4½" x 7½" and opens at the end, is intended for use in connection with a system of shop visits which is maintained at Lehigh University. In it there are a series of questions asked the student, relating to each department of an engineering works, including the machine shop, blacksmith shop, pattern shop and foundry. The questions relate to the tools and processes to be seen in these various departments, and require full explanations in writing, with numerous sketches, to furnish which will evidently require considerable observation by the student, and help him to acquire the habit of accurate and close observation, which is so necessary, and at the same time familiarize him with the technical names of the various machines and parts of machines and tools used. There are, besides, a great many drawings of forgings, patterns, castings and finished parts of machines which the student is required to describe the making of, giving free-hand sketches showing each step in the process and the tools and appliances used; these pieces not being made in the shops at the time of the student's visit to them. The book is, in short, a means of securing a thorough and systematic course of observation as a substitute for actual shop experience, and seems admirably adapted to that purpose. We should think that, for young men who have finally decided to study and adopt engineering as a profession, and to dispense with actual shop practice, this book would be a very useful one.

Though intended in part for the instruction of students, in the use of technical terms, one notices a few instances which seem to indicate that the author had come a little short of that entire familiarity with such terms that most experienced and intelligent shop men possess. An instance of this is seen in the first sentence of the first division of the book, relating to the machine shop, where the student is asked to "describe the features which characterize the different kinds of engine or power lathes," as though the terms engine lathe and power lathe were synonymous. We think that the book would prove useful in the hands of an intelligent apprentice to either of the trades mentioned, and would, if thoroughly used, help very much in acquiring a general knowledge of and familiarity with the different processes involved in the production of finished machines, not by giving him the information direct, but by helping him to seek it in a systematic way,

and would be useful in pointing out to him the particular lines upon which his investigation could profitably be carried on.

## QUESTIONS AND ANSWERS

*Under this head we propose to answer questions sent us, pertaining to our specialty, correctly and according to common-sense methods.*

*Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.*

(228) If G. T. W., New York, who inquires about paint and varnish to withstand heat, will inquire of manufacturers of paints, they will give him the information he desires. The Joseph Dixon Crucible Company, Jersey City, N. J., are large manufacturers of such paints.

(229) W. H., ——, writes: I have two gears which I wish to cut spiral at an angle of 45°. The distance between centers is 2½ inches, and they are to be cut 12 pitch. The gears are to be the same size. How many teeth should there be in each? *A.*—24. 2. Is there a rule for calculating the number of teeth of spiral gearing for all angles and pitches? If so, please give it. *A.*—The rule is the same as for ordinary spur gearing. Multiply the pitch by the pitch diameter. 3. Should the gears above mentioned be turned the same size as they would be if the teeth were straight instead of spiral? *A.*—Yes.

(230) Radius, Canada, asks: Which is the correct radius for a link (such as is used for an ordinary American locomotive) to suit a rocker whose lower arm is ⅜ of an inch out of line with its upper arm? *A.*—Connect the upper rocker arm to the valve; set the valve in its central position, and measure the distance from the center of the driving axle to the center of the lower rocker arm pin; this distance will be the radius of the link. Occasionally master mechanics will use a radius slightly different from the one just given; the latter radius is the one generally adopted, and in practice we believe, will give the best results.

(231) W. J. D., Campbellton, N. B., writes: I have a vertical boiler, 48 inches high, 36 inches diameter, sixty tubes 2 inches diameter, 24 inches long. The tubes leak very much in the top sheet. 1. Do you prefer tubes beaded in top sheet? *A.*—If the tubes are properly expanded, beading will have but very little effect in increasing their tightness. 2. What do you think of putting rings in the top of tubes? *A.*—Thin copper ferrules placed between the tubes and flue-sheet will have a tendency to prevent leaks, and will give excellent results when the tubes have considerable play in the holes in which they are to be expanded. These ferrules are about ⅛ of an inch thick at one end, and bored out tapered, so as to form a knife edge at the other end of the ferrule; the tube is slightly tapered at the end to receive the ferrule, and both are then expanded. We do not favor rings placed inside of the tubes. 3 What do you think of putting stays through the flue-sheets? *A.*—Stays should be placed wherever the weakness of a boiler may demand. Unless we have a drawing of your boiler, we cannot say whether stays through the flue-sheet are required or not.

(232) R. B. H., Chester, Pa., writes: Please tell me how to get the length of an arc, or perhaps you will call it the circumference. *A.*—The circumference of a circle is found by multiplying the diameter by 3.1416. To find the length of an arc when the number of degrees of the angle subtended by the arc are known, multiply the number of degrees in the angle by the circumference, and divide by 360; the quotient will be the length of the arc. Example: The lines drawn from the extremities of an arc to the center from which it has been described form an angle of 60 degrees; the radius is 12 inches; what will be the length of the arc? First find the circumference of the circle of which the arc is a part. The diameter of this circle is $12 \times 2 = 24$ inches; and the circumference is equal to $24 \times 3.1416 = 75.3984$ inches. Multiplying this circumference by the number of degrees of the angle subtended by the arc, we have $75.3984 \times 60 = 4523.9040$; dividing this product by 360, we have $\frac{4523.9040}{360} =$ 12.56+ inches, say 12 9-16 inches, which is the length of the arc. The foregoing rule is based upon the principle that the length of a given arc is to the circumference as the number of degrees in the angle subtended by the arc is to 360 degrees.

(233) F. F., Oakland, Cal., writes: I have a small sailing schooner, 68 registered tons; 90 feet over all; 24 feet beam and 6 feet 8 inches depth of hold. She carries one hundred thousand feet of lumber, and is a fine sailer under canvas. I am running from San Francisco up the coast a distance of about one hundred miles. I wish to put steam power into her, only to be used when there is no wind, and going in and out of ports. Her speed is to be about 4 or 5 knots an hour. I want something with as little machinery as possible. Can you advise me what kind of machinery would be the most suitable for that purpose? I am running her entirely in salt water, and wish to carry but very little fresh water. Can a single high-pressure engine be used with a condenser, and without an air-pump? *A.*—You will need a condensing engine, and of course an air-pump. But the exact type and size of engine we cannot give without knowing more of the boat and the service. It seems to us that, since in all probability you will not build the engine yourself, the best plan would be to allow the firm which undertakes to build the engines to make their own design, suitable for the service into which you may wish to put the boat. Such a course will not cause you any extra expense, and will be more satisfactory in the end.

## BUSINESS SPECIALS

*Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Thursday for the ensuing week's issue*


Gear wheels and g-cutting. Grant, see adv., p. 16.

Link-Belting and Sprocket Wheels.
Send for Catalogue of Link-Belting.
Over 50,000,000 feet of Link-Belt in use.
Link-Belt Engineering Co., Philadelphia and N. Y.

20″ Upright Drills. J. E Snyder, Worcester, Mass.
23″ Upright Drills. J. E. Snyder, Worcester, Mass.
25″ Upright Drills. J. E. Snyder, Worcester, Mass.
28″ Upright Drills. J. E. Snyder, Worcester, Mass.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Drop Presses, Punches and Shears. Williams, White & Co., Moline, Ill., manufacturers.

S. W. Card & Co., Mansfield, Mass., carry a full line of Stay Bolt and Patch Bolt Taps.

R. Dudgeon, 24 Columbia st., New York. Improved Hydraulic Jacks and Roller Tube Expanders.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

The best Upright Hammers run by belt are made by Jenkins & Lingle, Bellefonte, Pa.

Ice and Refrigerating Machines, 131 sold, and all successful. David Bovle, 521 Monroe st., Chicago, Ill.

"How to Keep Boilers Clean." A 96-page book mailed free by Jas. E. Hotchkiss, 120 Liberty st., N. Y.

Selden Packing for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Best silk wiping towels for machinery in the market. S. A. Smith, 23 S. Canal st., Chicago, Ill.

Iron Planers from 16″ to 36″ wide by any length. H. C. Pease & Co., Worcester, Mass.

Man'f'rs of Sash Weights, write to Humphrey & Good, Bellefontaine, O., for valuable information.

For the latest improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

Send $1 for Catalogue D, Fine Tools and Supplies. Over 550 pages. Fully illustrated. Frasse & Co., 92 Park Row, New York.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Split Pulleys at low prices and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker st., Philadelphia, Pa.

See illustration of Portable Key-Seating Machine in April 4 issue. For further particulars address T. C. Dill Mach. Co., 726 Girard av., Philadelphia, Pa.

Curtis Pressure Regulators. Curtis Return Trap. Curtis Damper Regulator. See May 9, p. 15. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

The best Emery Wheel made is the "Norwich." For particulars send to Montgomery & Co., 105 Fulton st., New York.

The Holly Manufacturing Company, of Lockport, N. Y., will send, on application, their pamphlet illustrating pumping machinery and reports of duty trials.

W. H. Hoffman, consulting engineer, 108 Liberty st., room 3, N. Y. Mechanical engineering in all its branches, working drawings for the transmission of power by steam, water, air and electricity.

Contract work of all kinds executed promptly and on reasonable terms. Parties wishing grey iron castings in large quantities can make money by corresponding with Rawson Mfg. Co., Hornellsville, N. Y.

Steam Boilers: Their management and working on land and sea. By Jas. Peattie. Practical facts from 30 years' experience. 230 pages illustrated, 12mo., cloth, $2.00. Circulars and Catalogue of Books for engineers free. E. & F. N. Spon, 12 Cortlandt st., N Y.

Patent or shop rights for sale, for perforating iron or steel plates for steam boilers, bridge work, iron or steel ship work, marine boiler heads, equal to drilled work and fifteen times quicker. Samples can be seen and circulars obtained from R. E. Dietz, 60 Laight St., New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 15 Astor place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G Co., 96 Fulton st., New York.

"Practical Drawing." By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October 23, 1886 issue, and up to and including May 23, 1889 issue, 77 articles have been so far published. Copies containing these articles sent by mail to any part of this country or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING Co., 96 Fulton st., New York.

"Modern Locomotive Construction." By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 92 articles have thus far appeared up to and including the May 30, 1889 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada, at 5 cents each. AMERICAN MACHINIST PUBLISHING Co., 96 Fulton st., New York.


## MANUFACTURES

J. T. Wilder will build a machine shop and foundry at Blacksburg, S. C.

The Roy Lock Nut Company has been incorporated at Cincinnati, Ohio.

The Batesville (Ark.) & Brinkley Railroad Co. will rebuild their machine shops, recently burned.

The Stewart Boiler Works, Worcester, Mass., has purchased land upon which to build new shops.

It is said there is a project to consolidate all the iron companies in Birmingham, Ala., and vicinity.

The Florida Central and Peninsular Railroad Co. will build shops at Fernandina, Fla., to cost $100,000.

E. G. Morris & Son contemplate the removal of their machine works from Morrisville, Ala., to Cedartown, Ga.

The Winnipisiogee Paper Company, at Franklin, N. H., will build a mill about 100 feet square for the manufacture of sulphite paper.

The Logan, Swift & Brigham Envelope Company, of Worcester, Mass., has decided to erect a new factory this summer, and the plans for the building are now nearly completed.

N. M. Jones, John O'Connell and H. P. Bradford have applied for a franchise to lay gas mains at Pine Bluff, Ark. They will build gas works with a daily capacity of 200,000 feet.

It is thought that the new wire rod mill, at New Castle, Pa., will be completed in August. About 150 tons of wire will be turned out daily, 100 tons of which will be used in the nail works.

The Red River, Sabine & Western Railroad Co. have accepted the proposition of the citizens to take $20,000 of bonds and donate 20 acres of land for a depot and machine shops at Palestine, Texas.

The new factory of the Cheshire Shoe Company at Pittsfield, Mass., will contain about 30,000 feet of floor room, and will be one of the largest and most complete shoe factories in the country. Work on it will begin soon.

The Scranton Iron & Brass Co., Scranton, Pa., has issued a circular describing the Wilson sliding door hanger, of which this company is sole manufacturer. The circular contains cuts, and describes the manner of applying the device.

The Spring Manufacturing Company has been organized at Martinsburg, W. Va., for the purpose of manufacturing wagons and agricultural implements; the capital stock is $25,000, with the privilege of increasing it to $100,000.

The Cornell Mills Corporation, Fall River, Mass., has been formed, with John D. Flint, president; John W. Hargraves, treasurer; Reuben Hargraves, Daniel H. Cornell, James F. Jackson, Stephen A. Jenks, R. P. Snelling, Arthur L. Kelley and Myron Fish, directors. The capital is $400,000.

The Allegheny City (Pa.) Select Council, at a meeting a few days since concluded to advertise for proposals for an electric light plant, to be erected and operated for six months by the bidder, and then, if satisfactory, to be bought by the city.

Pittsburgh (Pa.) is soon to have two new street railways. The Diamond Street Railway Company, with a capital of $30,000, chartered this week, will build a line five miles long. The Bellevue and Pittsburgh Street Railway Company, capital $48,000, lately chartered, will put down a line eight miles in length.

Geo. Richards & Co., Broadheath, near Manchester, England, send us what is termed a pocket edition of their machine tools and tool room appliances. The catalogue is an excellent one. It contains cuts of a great variety of machines, and tools for metal-working; also of steam engines, shafting and its equipments, etc.

The name of the Milwaukee Machine Tool Company has been changed to the Kempsmith Machine Tool Company, taking this name from Mr. Frank Kempsmith, who is at the head of the mechanical department. The company is to manufacture iron and brass working machinery, and are about to bring out a new milling machine.

J. W. Himes, of the Diamond Knitting Mill, of Cohoes, N. Y., who is interested with a syndicate of Boston capitalists, will build a new mill at Northside, N. Y. The proposed mill will be 150x60 feet, and five stories high, and will be used for the manufacture of Jersey cloth. Three hundred and fifty persons will be employed. The capital is $250,000.

The Glenmore Iron Company will erect a large plant on the Glenmore estate, three miles from White Sulphur Springs, W. Va. They have acquired 3,000 acres of land, upon which there is a vein of iron ore, from forty to sixty feet thick, and six miles long, which can be mined by open cutting. The Chesapeake and Ohio Railroad will run a branch line to the works and mines.

A Matamoras dispatch to the New Orleans *Times-Democrat* says: The Government has granted a charter for a railroad from this city to Bagdad, at the mouth of the Rio Grande, with a subsidy in bonds. It is hoped here that Bagdad will, when the road is completed, become the entry port for goods coming into North Mexico. The *Revista* says that General Geronimo Trevino, General Bernardo Reyes, Governor Garza Ayala and Senor Pedro Martinez have received a charter to construct a railroad on the route proposed, under the Telfener concession.

The machinery of the Birmingham Lock Co., at Bessemer, Ala., is in place, and work has begun. The plant consists of a main building 200x40 feet on the ground, and two stories high, with an L at each end, 75x50 feet, and one story high. Between the Ls is the engine house 40x25 feet, which contains a 100 horse power Hamilton-Corliss engine, and a 150 horse-power steel boiler.

John Gilman, representing the Hartford & Worcester Railroad Company, recently addressed a meeting of manufacturers of Rockville, Conn., upon a proposed road from Stafford Springs to Hartford by way of Rockville. A committee was chosen to obtain funds for a survey of the route by which the railroad distance between Boston and Hartford will be lessened fifteen miles.

A charter has been filed in the recorder's office for the Monongahela Furnace Company, to be located at McKeesport, Pa. The capital stock is $1,000,000, divided into 10,000 shares at $100 per share. The directors are D. W. Hitchcock, S. W. Whitmarsh, J. H. Flager, E. C. Converse, Horace Crosbey, C. J. O'Connor, and E. W. Converse. William S. Eaton, of Boston, Mass., is treasurer.

The citizens of Spokane Falls, Washington Territory, have subscribed $30,000 towards the capital stock requisite for the establishment of a woolen mill on the Falls of Spokane river, and invite correspondence from men of capital and experience, who would join with them in the enterprise. Last year's production of wool in Oregon and Washington amounted to 10,000,000 pounds.

There is water-works agitation at Harrodsburg, Ky.; Baltimore, Md.; Johnson City, Tenn.; Fort Worth, Texas; Gordonsville, Va.; Green Forest, Va.; Milton, Mass.; Burlington, Wis.; Sanford, Me.; Centreville, Md.; Salamanca, N. Y.; Fairhaven, Mass.; North Brookfield, Mass.; Du Quoin, Ill. Hendersonville, N. C.; Andover, Mass.; Yuba City, Cal.; St. Paul, Minn.; Hempstead, L. I.; Sturgis, Mich.; Niles, Mich.

A new silk mill will soon be erected at Riverside Park, N. J., which will furnish employment for a large number of operatives. When completed, the mill will be 250 feet long and 50 feet deep, and four stories in height, while a portion of 50 feet square will be five stories. The walls will be built of brick. A fire-proof silk vault, 50 feet square, of brick and cement, will be built beneath the mill. The cost of the structure is to be $50,000.

The Eastern Manufacturing Company has begun operations on the site of its proposed pulp mill at Brewer, Maine. The mill will be 280x90 feet, with a storage warehouse 80x30 feet. The boiler house will be a separate building, 154x63 feet in size, and of brick. There will be five steel boilers to be made according to specifications of the Hartford Steam Boiler Inspection and Insurance Company. An electric light plant will also be put in.

J. A. Dunkle and S. F. Dunkle, of Steelton, and J. C. B. Ewing, of Harrisburg, have bought the entire plant and good will of the Star Steam Heater Company, of Mount Joy, including the exclusive control of the patents. Large and commodious shops will at once be built at East Harrisburg, Pa., according to new plans especially adapted for their business. Three departments, viz., boiler making, machine and foundry, will be fully fitted out with machinery.

Jones & Mack, Cincinnati, Ohio, have issued a circular entirely unique in character. The leaves are small-size blue prints, and in this respect set forth in part the character of their work, as they do blue printing as part of their business. They also make special machinery, and tools for the duplication of parts, designing them for rapid work. This part of their work is set forth by a print very suggestive in its character, which must be seen to be appreciated. They also manufacture various specialties, design machinery, make drawings, assist inventors in perfecting machines, examine machinery for those at a distance contemplating purchasing, and do a general engineering business, which is set forth in their blue print circular.

A number of the new steel freight cars of this line (Vera Cruz) are expected shortly to arrive. The policy of the management has for a long time past been directed toward making the road-bed exceptionally solid, and a large amount of money has been invested in steel ties, which have proven well suited to the requirements of the line, known to be one of the most difficult of maintenance in the world, on account of its tremendous gradients. The good results of this wise building up of the line will be seen when the competition of the Interoceanic Railway begins, for then it will be made evident that, by having got its road-bed into a condition where it can be kept in repair at a comparatively small expense, the line can sustain a sharp rivalry. —*Mexican Financier.*

Work is going on rapidly at the Howland Mills, New Bedford [Mass.], and mill No. 2 is well under way. The two mills and the engine and boiler rooms will make three sides of a square, and in this square stand several large, handsome maples. The location, close to the bay, is very airy and pleasant, and the surroundings are very unlike the usual cotton mill environments. The company tenements are not unattractive homes, but pretty cottages, differing in size and design. Tenants are beginning the work of laying out lawns and flower beds about their residences. The houses are fitted up most conveniently. A boarding house is being erected, and this will be as unlike the usual mill boarding house as the cottages are unlike the usual mill house. There will be wide piazzas, giving a fine view of Buzzard's Bay, and the houses will be fitted with bath rooms and other modern conveniences. Twenty-five more houses are to be put up the present year.—*Boston Journal of Commerce.*

## Machinists' Supplies and Iron.

New York, May 25, 1889.

Iron—American Pig.—No material change in the general condition of the market has occurred since our last report, and the feeling seems to be quite general that the bottom has not yet been touched. We quote Lehigh No. 1 Foundry, $17; No. 2, $16. Southern brands are $1.00 less.

Scotch Pig.—Coltness, $21.50 to $21.75; Gartsherrie, $20; Summerlee, $21 to $21.50; Eglinton, $19 to $19.25; Dalmellington, $19.75 to $20; Clyde, $20.50, and Langloan, $20.50.

## ✲WANTED✲

*"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.*

A foundry superintendent wants situation or partnership. Address Box 101, American Machinist.

Wanted—A first-class machinist who is also a good tool dresser, for a shop 100 miles from New York. Address with refs., Manufr., Am. Machinist.

A young engineer wants a permanent situation; first-class references furnished. Address, stating style of engine and salary, E. E. P., Theresa, N. Y.

Wanted—Marine draftsman; good opportunity for one accustomed to iron ship-building, engine and boiler work. Marine, Box 299, Chester, Pa.

Wanted—By practical, experienced, pushing iron foundry foreman, a position as such on any class of work. Pusher, American Machinist.

Wanted—Position as foreman by first-class machinist; at present holding same position; heavy work preferred. Address Reliable, Am. Machinist.

Mech. draftsman (22), graduated at a German technical college, wants position; salary $10 weekly. Address Box 98, American Machinist.

Mech. engineer and draftsman, inventive and of progressive ideas, with good all-around experience, desires engagement. Address W. N., Am. Machinist.

Wanted A situation as foreman by an experienced pattern maker and draftsman well up in the work. Eng. and general machinery; Western location preferred. "Machinery, B.," Am. Machinist.

Wanted—A man to temper dies, taps and reamers. Must be competent and understand the best methods of tempering steel. Address Box 94, American Machinist.

Wanted—Situation by practical tool maker (36), accustomed to fine small work; fair draftsman; experienced in designing special tools and fixtures; willing to start on moderate salary if chance for advancement. Address Box 50, American Machinist.

Wanted—A thoroughly competent and energetic man, to take charge of about 100 men in the machine shop department of an agricultural implement factory in Western Canada; none but an expd. man need apply. Agricultural, American Machinist.

Wanted—A foreman to take charge of a small machine shop manufacturing special tools. To one fully competent, a good salary will be given or a permanent interest in the business. A young man preferred, and one who can give undoubted reference as to character and ability. Box 100, Am. Mach.

## ✢ MISCELLANEOUS WANTS ✢

*Advertisements will be inserted under this head at 35 cents per line, each insertion.*

Just out; aluminum-steel hack saws, hard but not brittle. Crescent Mfg. Co., Cleveland, O.

New catalogue of engineers' specialties free. Crescent Mfg. Co., Cleveland, O.

Steel Name Stamps, Copper Burning Brands, etc. W. G. Sackmann, 1099 First av., Cleveland, Ohio.

Light and fine machinery to order; Foot Lathe. Catalogue for stamp. E. O. Chase, Newark, N. J.

August C. Christensen, 24 State st., N. Y., Consulting Engineer. Designs of all kinds of Machinery.

Turned and Highly Polished Iron and Steel Shafting a specialty. Merwin McKaig, Cumberland, Md.

Engineers wanted to send their addresses and receive free a 25 cent book, "Hints and Suggestions for Steam Users." Lord & Co., P. O. Box 1262, Phila., Pa.

Room and power to rent to suit any capacity, large or small. Inquire of Hartford, Conn., Board of Trade.

Wanted—By a reliable foundry and machine company, a few specialties to manufacture; patented articles preferred. F. & M. Co., Am. Machinist.

Wanted—To buy second-hand lathes, planers and shapers of all sizes; must be cheap and in good order. Fosdick & Plucker, 6th and Culvert Streets, Cincinnati, O.

How to remove and prevent scale in steam boilers at a cost of ten cents a week. Send postal for circular to Pittsburgh Boiler Scale Resolvent Co., Pittsburgh, Pa.

Wanted—100 or more machinists or amateurs to send for model engine castings; complete in sets; send for circular. Lowell Model Co., 170 Merrimack Street, Lowell, Mass.

Wanted—At once, two combined punching and shearing machines, new or second-hand, to punch 1¼" hole in 1¼", and shear 1¼" with 30" gap, with or without eng's attached. State price delivered in Toronto. The Polson Iron Works Co. (Ltd.), Toronto.


**FOR SALE.**

**40 lbs. BRADLEY CUSHIONED HAMMER in good order.**

**A. F. WHITIN, Treas., Whitinsville, Mass.**

**WANTED:**—Machinery to build. Specialties in CAST IRON to manufacture. Fine, solid CASTINGS for Dies, Moulds, Dynamos, Motors, &c. MANUFACTURER, P. O. Box 886, New Haven, Conn.

Established 1832. **BRADLEY'S POWER HAMMERS**

The BEST in the WORLD

RUN BY BELT.

Over 1500 in USE

**BRADLEY'S HEATING FORGES**

Indispensable in all shops to keep

**BRADLEY'S CUSHIONED HAMMERS**

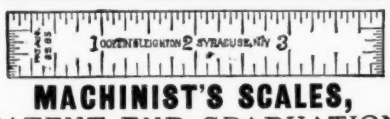
and men fully employed and reduce the cost of production.

BRADLEY & CO. SYRACUSE, N.Y.

63 Murray st. NEW YORK; 98 Sudbury st. BOSTON, MASS.

**SOLID EMERY OIL STONES AND Triple Coated KNIFE SHARPENER**

WHOLESALE ONLY BY THE TANITE CO., STROUDSBURG, PA.




**MACHINIST'S SCALES,**

PATENT END GRADUATION.

We Invite Comparison for Accuracy with all others.

EVERY SCALE GUARANTEED. SEND FOR LIST.

COFFIN & LEIGHTON, SYRACUSE, N. Y.

**SOLDERING** Iron and Steel may be done without causing **RUST**

by using our **Non-Corrosive** Soldering Fluid.

**Sample Bottle, prepaid, for 10 cents**

FOR SALE BY ALL DEALERS.

*STERLING ELLIOTT, NEWTON, MASS.*

We never sleep.

**JONES & ROGERS,**

5 West 4th St., Cincinnati, O.,

CONSULTING ENGINEERS AND BLUE PRINTERS.

*Machines Designed and Working Drawings Made.*

WRITE FOR ESTIMATES.

**WOOD-WORKING MACHINERY.**

**A HISTORY OF THE PLANING MILL.**

With practical suggestions for the Construction, Care and Management of Wood-working Machinery. By C. R. Tompkins, M. E. 12mo, cloth, $1.50.

**JOHN WILEY & SONS, New York,**

PUBLISHERS OF SCIENTIFIC AND INDUSTRIAL WORKS.

*** Catalogues Supplied gratis and free by Mail to order

SEND FOR CATALOGUE.

**WORCESTER MACHINE SCREW CO.**

Manufacturers of Set, Cap & Machine Screws, Studs, etc.

**FOR SALE.**

**A Valuable Plant of Machinery, consisting of**

Milling Machines.
Screw "
Engine Lathes.
Drill Presses.
Heavy Drops and Presses, &c., &c.
Also Tools, Belting, and Factory Fixtures.
Formerly the property of "The Howe Sewing Machine Co."

Address THE NEW HOWE MFG. CO.,

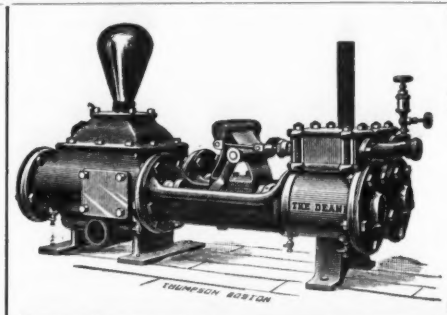
Bridgeport, Conn.

**FOR SALE. A MACHINE SHOP**

With a good water-power and equipped with a fine lot of tools, in a large village in Western N. Y. Said plant is making special work, and has special tools for same, and a party is taking nearly its whole production and has had to place a large order elsewhere, on account of not being able to fill orders. Parties owning this are in other business and are not practical in this line, is the reason for selling. For full particulars, address

P., AMERICAN MACHINIST.

IMPROVED PUMPING MACHINERY | For Every Class of Work | Send for New Illustrated CATALOGUE.



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HOLYOKE, MASS.,

New York, Boston, Chicago, Philadelphia, St. Louis,

Manufacturers of

STEAM and POWER

**PUMPS**

FOR ALL PURPOSES.

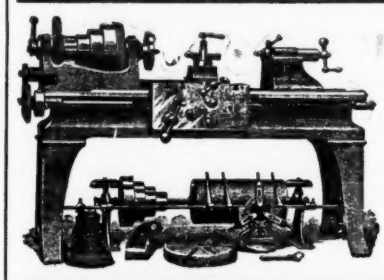
SEND FOR CATALOGUE.

**MILLER, METCALF & PARKIN,**

MANUFACTURERS OF

DIE TOOL SPRING MACHINERY SELF-HARDENED AND ALL KINDS OF **STEEL** OF BEST QUALITY. OF UNIFORM TEMPER. OF GREAT STRENGTH. IN BARS, BLOCKS, SHEETS, RODS & COILS.

CHICAGO, ILLS. PITTSBURGH, PA. NEW YORK, N. Y.



**SEBASTIAN, MAY & CO.'S**

—NEW—

**18-in. Engine Lathe.**

Just introduced. New design. All the latest improvements. Write for cuts and prices. Complete catalogue of foot and power lathes and tools mailed on application.

167 W. 2nd Street, Cincinnati, Ohio.

**STEPHENS' PATENT VISES.**

**QUICK-ADJUSTING CAM AND TOGGLE JOINT.**

Stationary or Patent Swivel Bases.

INCOMPARABLE FOR STRENGTH, DURABILITY, FIRM HOLD AND QUICK WORK.

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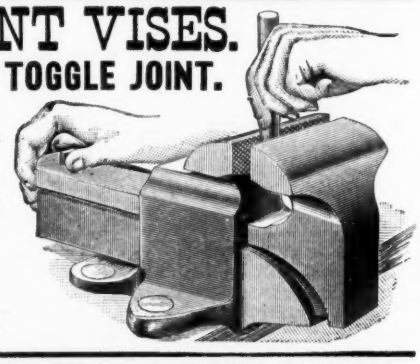

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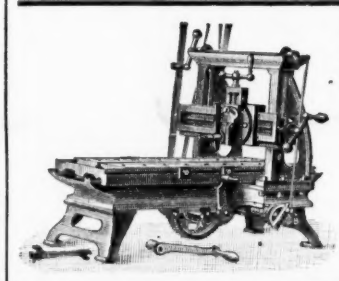

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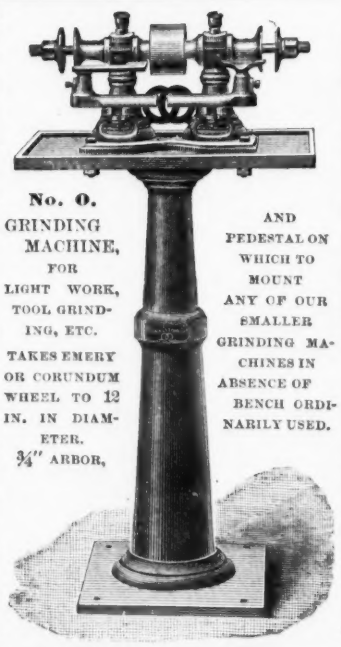

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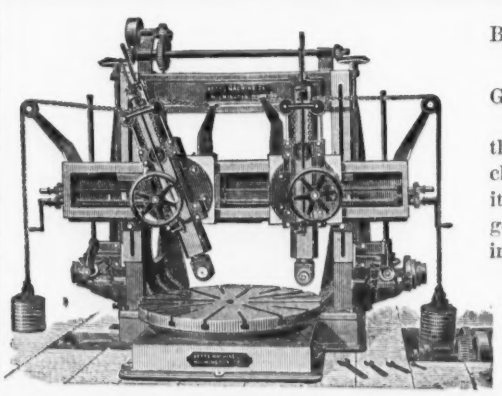

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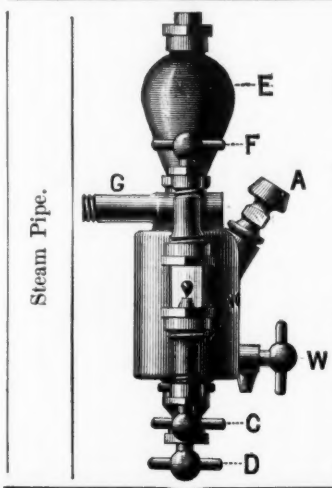


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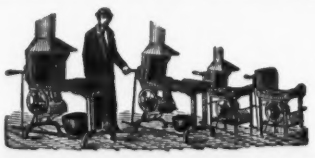

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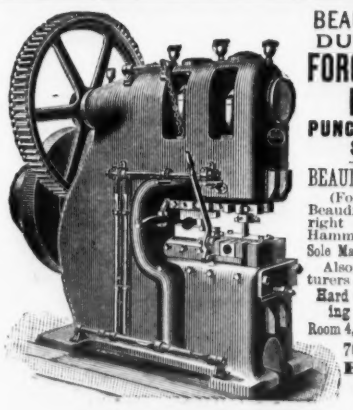

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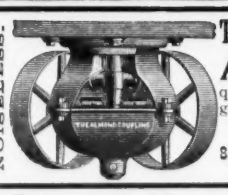


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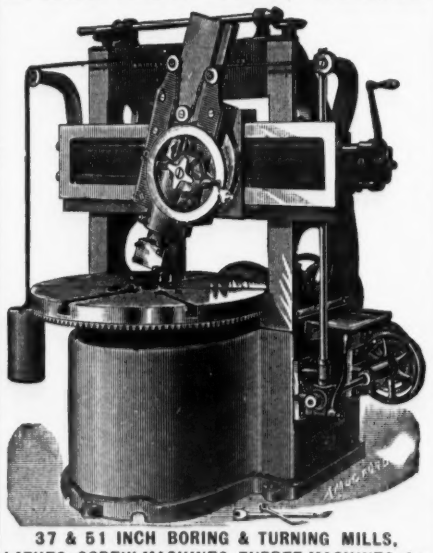

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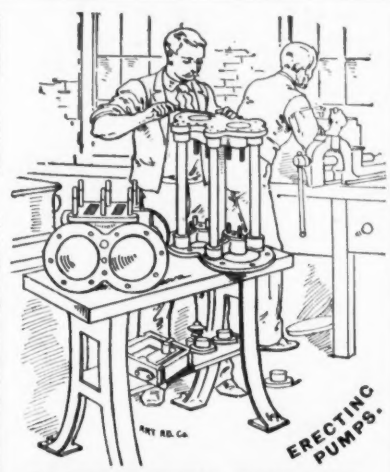


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| 11 | 1 3-4 | 1.10 |
| 12 | 2 | 1.20 |
| 13 | 2 1-4 | 1.35 |
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| 15 | 3 | 1.60 |
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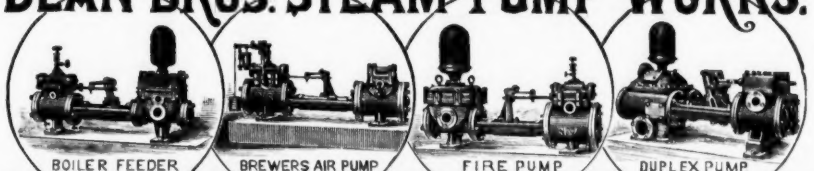


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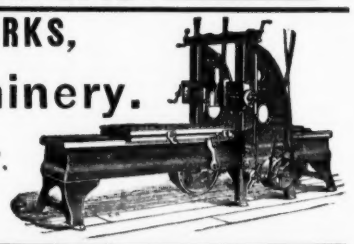

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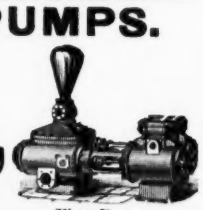
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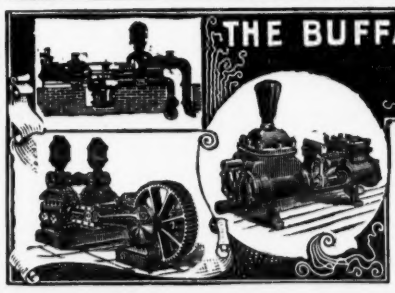

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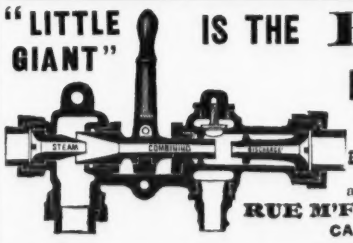


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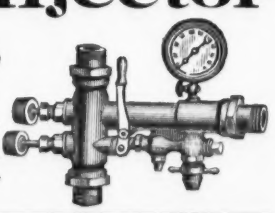

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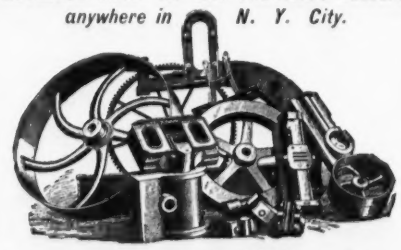

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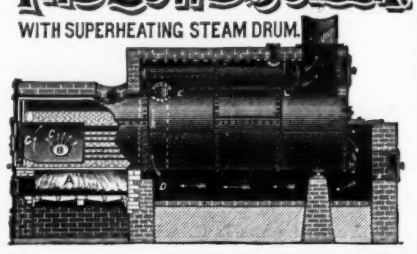

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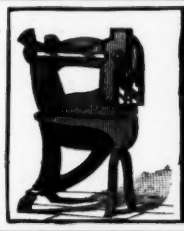

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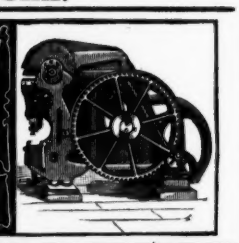

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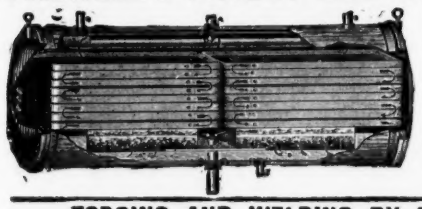

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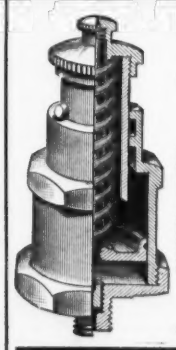

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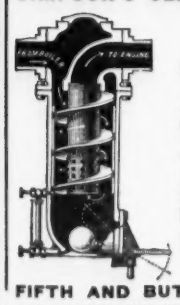

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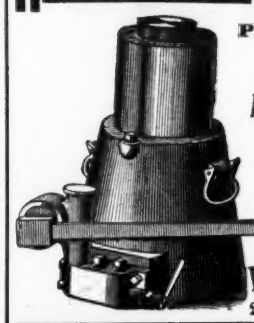

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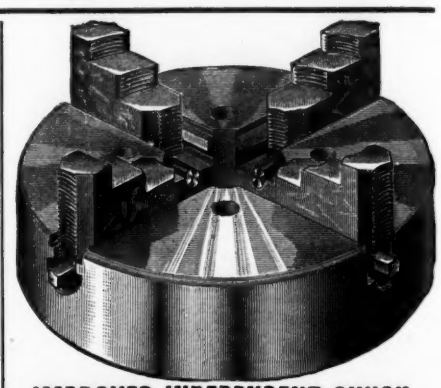

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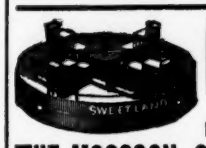


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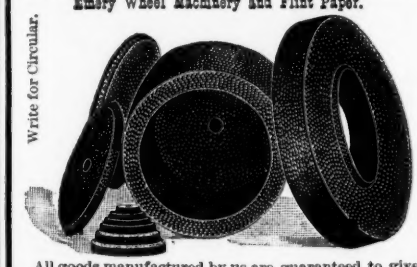

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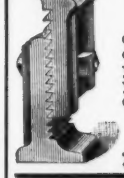

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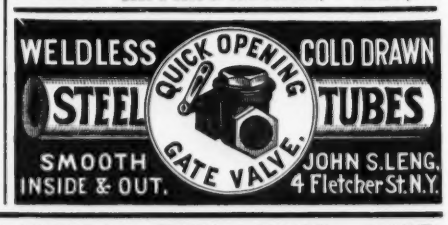


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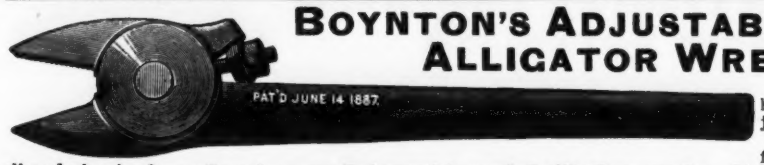

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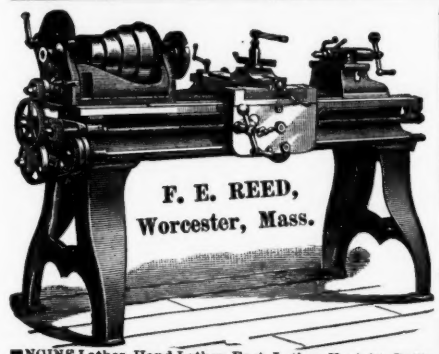

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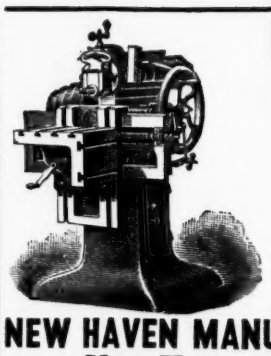

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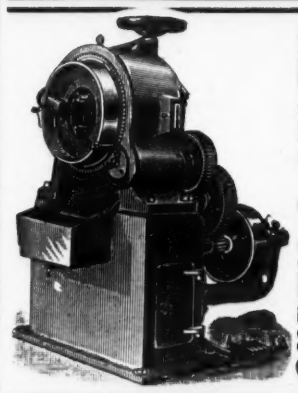

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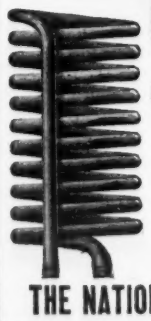

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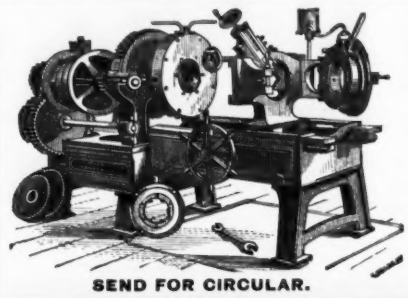

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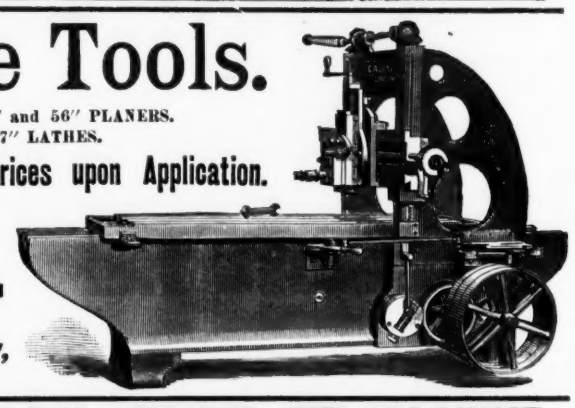

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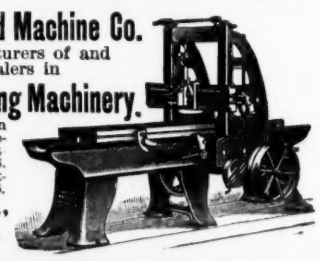

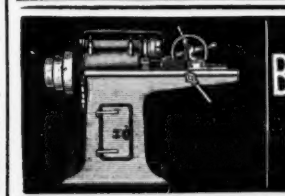

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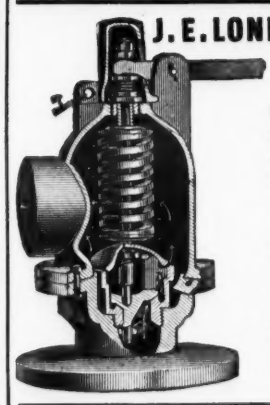

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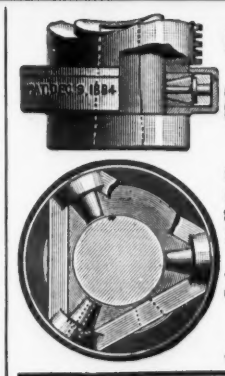

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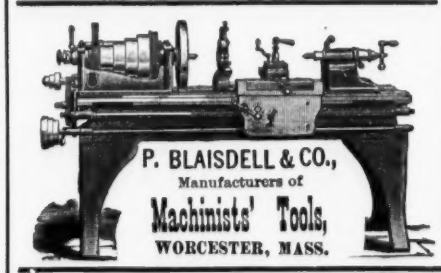

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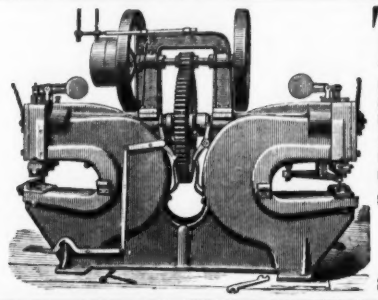

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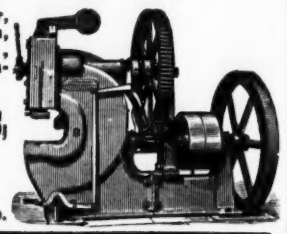

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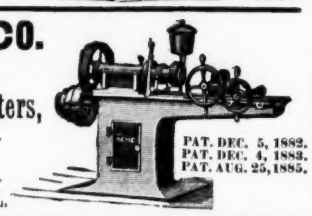
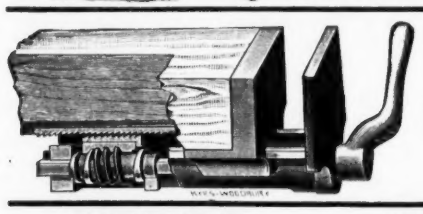


PAT. DEC. 5, 1882.
PAT. DEC. 4, 1883.
PAT. AUG. 25, 1885.



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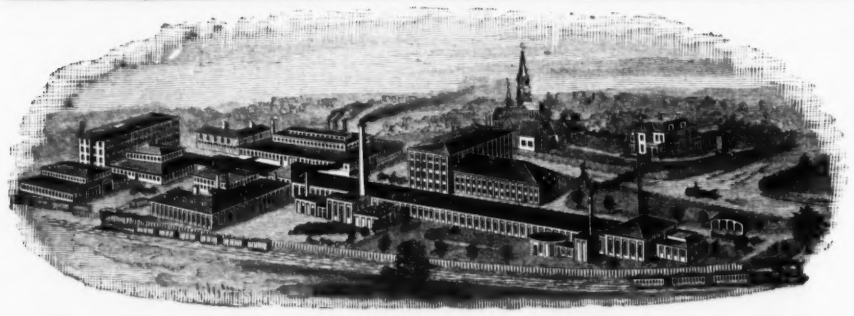

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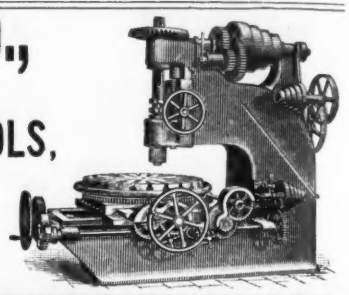

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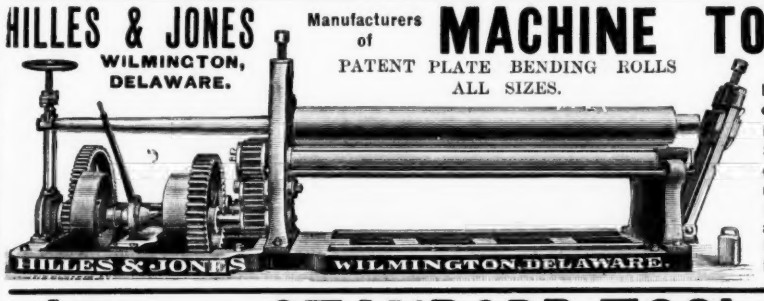


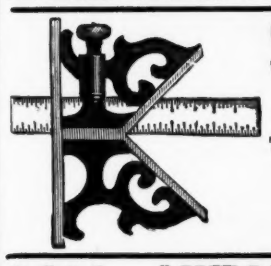

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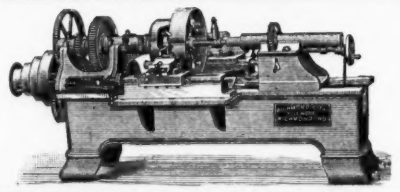

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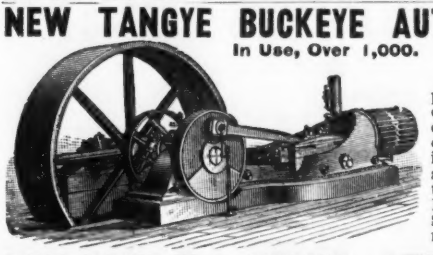

These engines are the combined result of long experience with automatic cut-off regulation, and most careful revision of all details. They are designed and constructed for heavy and continuous duty at medium or high rotative speeds. Highest attainable Economy in Steam Consumption and superior regulation guaranteed. Self-contained Automatic Cut-off Engines 12 to 100 H. P. for driving Dynamo Machines *a specialty*. Illustrated Circulars, with various data as to practical Steam Engine Construction and performance, free by mail. **Address, BUCKEYE ENGINE CO., Salem, Ohio.**

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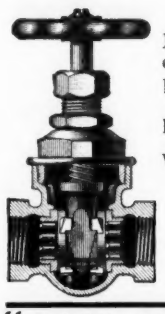

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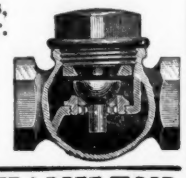

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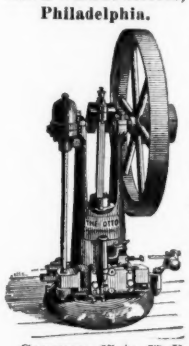

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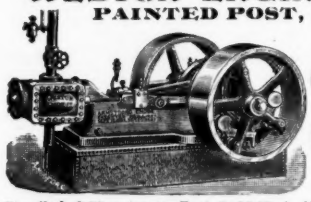

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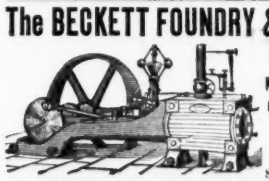

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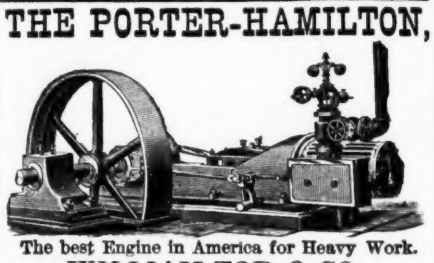

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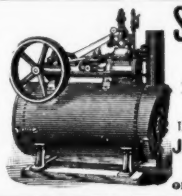

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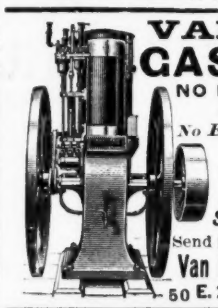

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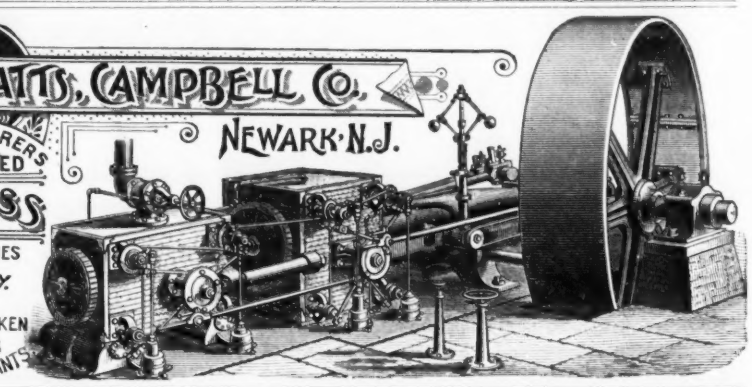

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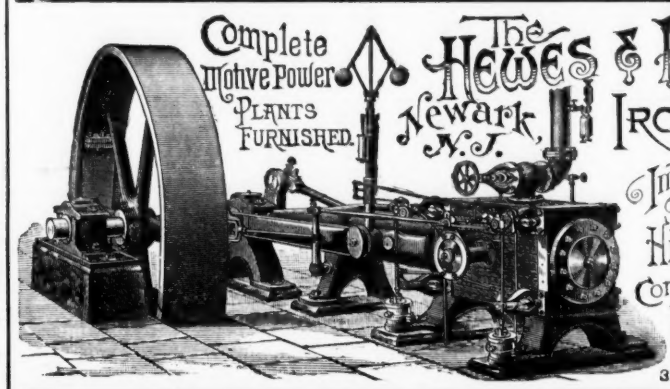

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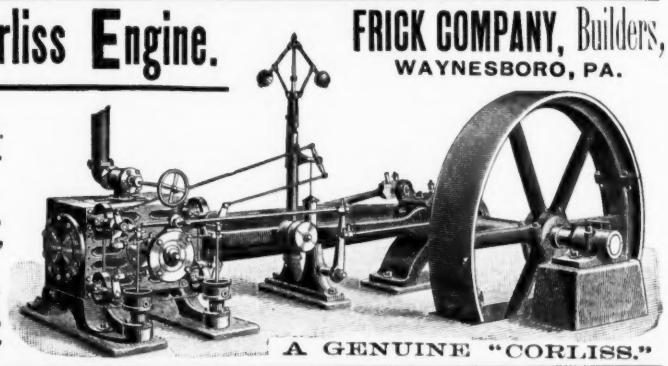

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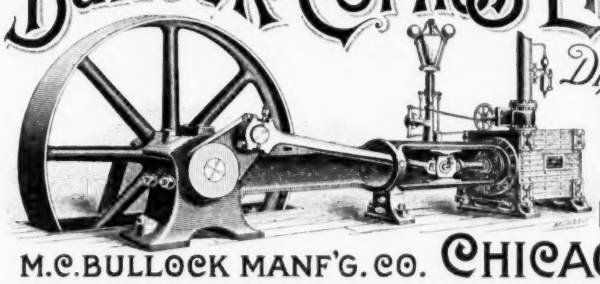

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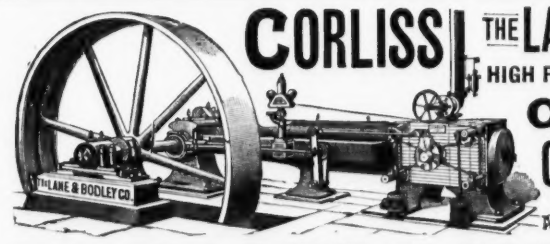

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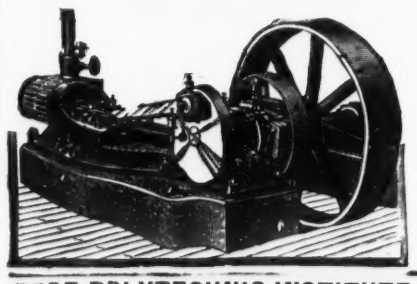

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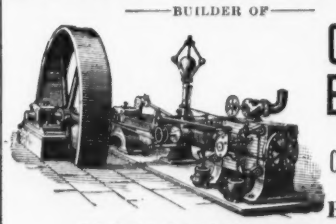

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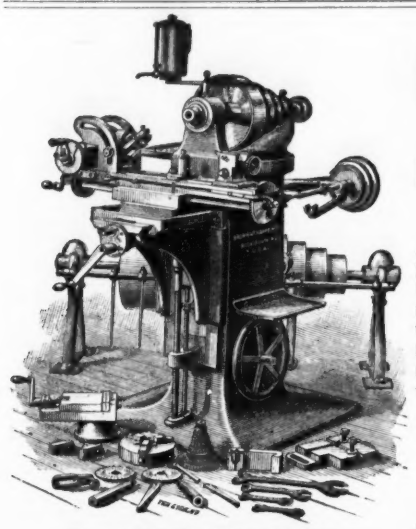

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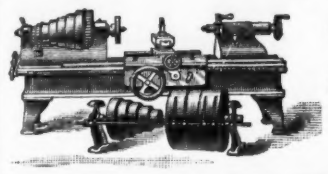

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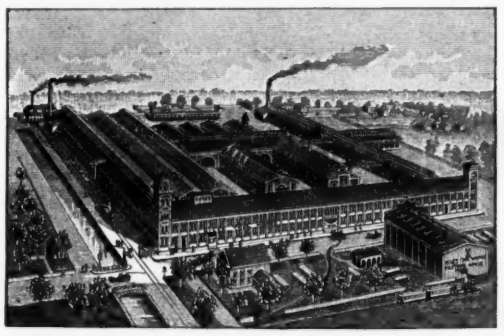

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A machine shop 500′ long by 100′ wide; a foundry 250′ long by 90′ wide; also commodious buildings for the storage of sand, coal, coke and pig iron; ample and convenient wash rooms for the men; fireproof two story pattern storage; blacksmith shop; engine and boiler houses. These buildings are detached from the machine shop and foundry. There is an elevated railroad for the convenient distribution of raw materials, and a railroad running through the machine shop for shipping. The whole plant is supplied with the incandescent system of electric lighting.

The machine shop and foundry have overhead traveling cranes running through their entire lengths; also light traveling cranes, which serve every tool, and a number of jib cranes in the foundry and scratch rooms. The foundry has capacity for making the heaviest class of castings.

All our tools are expressly designed for the economical manufacture of heavy machinery for railroad and general machine shop equipment, from new patterns of the latest and best designs.

SALESROOM and OFFICE, 111 & 113 Liberty St., N. Y. City.
NEW SHOPS. Plainfield, N. J.

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## GRANES

THE YALE & TOWNE MFG CO.
STAMFORD CONN
NEW YORK CHICAGO PHILA BOSTON

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## JENKINS BROS.' VALVES.

Every valve tested and warranted, all parts interchangeable.
Nothing but best Steam Metal used in the manufacture.
JENKINS Key-eyed Stuffing Box and Disc Removing Lock Nut
Is used only in the Jenkins Bros.' Valves.
None are genuine unless stamped with "Trade Mark."
Should you order INSIST on having Jenkins Bros.' Valves.

*71 JOHN STREET, NEW YORK.* *54 DEARBORN STREET, CHICAGO.*
*21 NORTH FIFTH STREET, PHILA.* *105 MILK STREET, BOSTON.*

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## GEO. W. FIELD,

MANUFACTURER OF

## ENGINE LATHES

FROM 16 to 48 IN. SWING.

Cuts, Photographs and Prices furnished on application.

Lowell, Mass., U. S. A.

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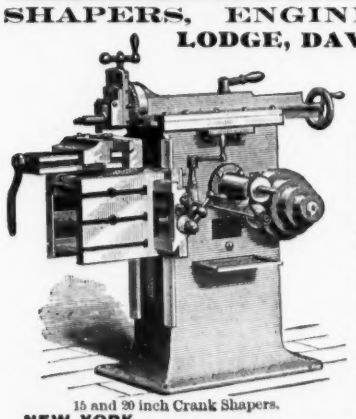
## SHAPERS, ENGINE LATHES AND DRILLS.

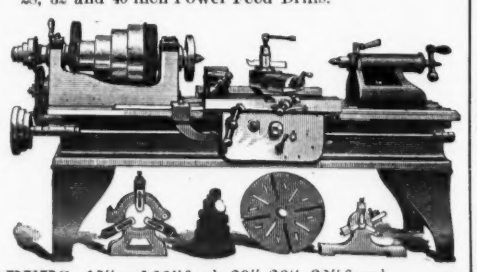
**LODGE, DAVIS & CO., CINCINNATI, OHIO.**



15 and 20 inch Crank Shapers.

WRITE FOR PRICES, IT WILL PAY YOU.

20 inch Upright Drills. 25 inch Back Geared, and
24 " " "
28, 32 and 40 inch Power Feed Drills.



**SHAPERS,** 15″ and 20″ Crank, 20″, 26″, 32″ Geared.
**ENGINE LATHES,** 17″, 19″, 21″, 24″, 27″, and 38″.
(See advertisement, page 15.)

NEW YORK, 115 Liberty Street. BOSTON, 23 & 25 Purchase St. CHICAGO, Cor. Lake & Canal Sts.

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**Gear Wheels and Gear Cutting.**—I make g to order, or cut teeth on g blanks sent to me. Of all kinds. Of all sizes to six ft. dim. Small orders or large ones. Fine g or cheap g. Small cast g. Ready made brass g by mail at low prices. Bevel g with perfect planed teeth. Hand Book on g, $1. Facilities complete. Terms reasonable. Send for cat.
GEO. B. GRANT, 66 Beverly St., Boston, Mass.

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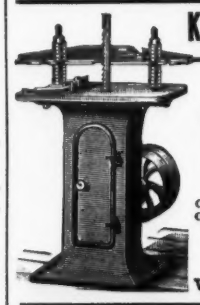

## Key-Seating Machines and 20 in. Drills

A SPECIALTY.

SEND FOR LIST OF

**New and Second-Hand**

**Lathes, Planers, Drills,** or anything in Machinists' Tools or Supplies.

**W. P. DAVIS,**
Rochester, N. Y.
Works at North Bloomfield.

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PATENT UNIVERSAL SCREW-CUTTING CENTER DEPTH ANGLE AND **TWIST DRILL GAUGE.**
J. WYKE & CO., Fine Machinists' Tools.—E. Boston, Mass—Send for Circular

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NEW CATALOGUE

## MACHINE TOOLS.

THE G. A. GRAY CO.,
477-481 SYCAMORE ST., CINCINNATI, O.
See advertisement, page 13.

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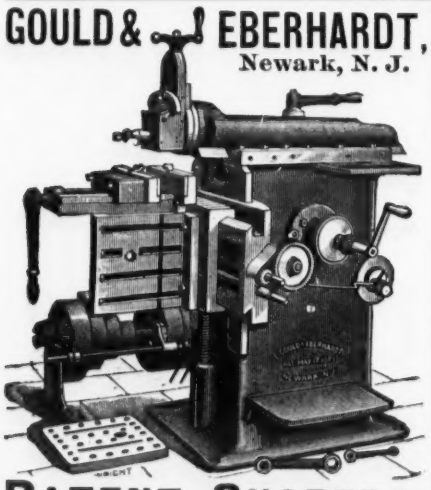
## GOULD & EBERHARDT,

Newark, N. J.



## PATENT SHAPERS.

Sizes, 12″, 16″, 24″, 26″, 30″ in stock.
*GEAR AND RACK CUTTING TO ORDER.*

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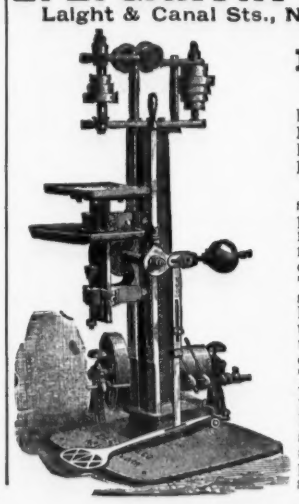
## E. E. GARVIN & CO.,

Laight & Canal Sts., New York,



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**Machinists' Tools,**

**Including Milling Machines, Drill Presses, Hand Lathes, &c.**

The machine shown in cut is especially designed for jobbing, and is fitted up with one or two spindles. Those with two spindles have pulley, with two sections, which gives two speeds to each spindle. Those fitted up with one spindle have a cone pulley with three sizes. The back shaft has a cone pulley with four sizes.

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## STEEL CASTINGS.

PRATT & LETCHWORTH,
PROPRIETORS
BUFFALO STEEL FOUNDRY,
BUFFALO, N. Y.

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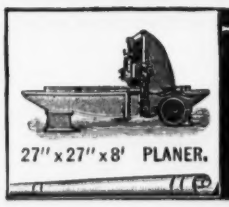

27″ x 27″ x 8′ PLANER.

## The Hendey Machine Co.

IRON & BRASS WORKING **MACHINE TOOLS**

TORRINGTON, CONN.

SEND FOR OUR CATALOGUE

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## HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.

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